City of San Jose
Waste Characterization Study

Final Report - DRAFT

May 2008

Prepared by
Cascadia Consulting Group, Inc.

In cooperation with
Environmental Planning Consultants
MidAtlantic Solid Waste Consultants
Sky Valley Associates

Table of Contents

Tables

Charts

I. INTRODUCTION AND SUMMARY OF FINDINGS

A. Overview and Objectives

The City of San Jose Environmental Services Department contracted with Cascadia Consulting Group to design and implement a waste characterization study that addressed several of the largest sectors of the City's municipal solid waste (MSW) stream as well as the single-family residential recycling stream. The disposed waste and recycling sectors that were characterized consisted of:

- Single-family residential waste
- Single-family residential recycling
- Residual waste from material recovery facilities
- Commercial waste.

Broadly, the objectives of the study were as follows:

- Determine the composition of single-family residential disposed waste and the prevalence of recoverable materials still being disposed of in that waste stream.
- Determine the composition of curbside recyclables from single-family residential collection routes and the amount of material in those set-outs that is not considered recyclable by local material recovery facilities (MRFs).
- Determine the composition of residual materials from MRF processing of single-family residential recyclables, as well as the appropriateness of the residuals for waste-to-energy applications.
- Determine the composition of commercial disposed waste discarded via each of three types of vehicles or containers – front loaders, compactors, and debris boxes.

Data collection took place during the two-week period of March 17-28, 2008. The study employed hand-sorting and visual characterization of waste and recycling samples to derive statistically valid estimates of the composition of each material stream. For the residential portion of the study, households within each district were selected at random, and garbage and recycling set-outs were collected from those households before being hand-sorted and characterized. For residential MRF residuals, samples of material were obtained at the discard points at two local MRFs and were hand-sorted and characterized. Loads of commercial waste corresponding to each of the three container/vehicle types were randomly selected from lists of scheduled or on-call collection trips by local waste haulers. Samples of waste were then taken from most of the selected loads and were hand-sorted. Some loads were better suited to visual characterization, and approximately half of selected loads in commercial debris boxes were characterized using this alternative method.

This document presents the findings of the waste characterization study.

B. Summary of Findings

Detailed findings regarding the composition of the four material streams are presented in subsequent sections of the report. However, certain findings stand out as representing opportunities or achievements with respect to waste reduction and recycling.

- Approximately 70% of the waste disposed by San Jose’s single-family residents could be diverted from disposal in landfills.

- Nearly 52% of disposed waste from single-family residences is compostable (consisting of compostable paper, green waste or food), and about 19% is potentially recyclable (including significant amounts of paper, plastics, metals , glass, and textiles).
- Contamination (consisting of non-recyclable and organic materials) in the recycling set-outs collected from single-family residences exceeds 25%.
- By weight, over 80% of the residual material that is discarded from the two residential MRFs used by the City's contractors has energy value.
- Of the material in MRF residuals that has energy value, about half of it is compostable or digestible, while the other half would be best converted to energy through direct or indirect combustion.
- Almost 80% of San Jose's disposed commercial waste stream potentially could be diverted from disposal in landfills.
- About 46% of disposed commercial waste is potentially recyclable (including substantial amounts of paper, cardboard, and wood) and another 33% is compostable (consisting of compostable paper, green waste, and food).

II. SUMMARY OF STUDY METHODS

A. Waste Sectors Defined

In consultation with City staff, the consultant team developed clear definitions of the material streams and substreams that were addressed by the study. The definitions are presented below.

Single-family residential waste was defined as the material placed in designated solid waste (garbage) containers originating from households that have individual, curbside collection service. The single-family residential waste stream was divided into substreams corresponding to each of the City's three Service Districts:

- Waste from households in Service District A, collected by California Waste Solutions (CWS)
- Waste from households in Service District B, collected by GreenTeam of San Jose (GreenTeam)
- Waste from households in Service District C, collected by CWS.

Single-family residential recycling was defined as the material placed in designated recycling containers originating from households that have individual, curbside collection service. The single-family residential recycling stream was divided into substreams corresponding to each of the City's three Service Districts:

- Recycling from households in Service District A, collected by CWS
- Recycling from households in Service District B, collected by GreenTeam
- Recycling from households in Service District C, collected by CWS.

Residual waste from material recovery facilities (MRFs) was defined as material that remains and is sent to landfill after collected loads of single-family residential recyclables are sent through the GreenTeam and CWS MRFs and the majority of recoverable materials are extracted. The GreenTeam and CWS MRFs are the two facilities that have contracts with the City to process collected loads of residential recyclables.

Commercial waste was defined as waste collected from a business by Allied or Stevens Creek, two of the approved collection franchises in the City of San Jose. The commercial waste stream was divided into three substreams corresponding to the type of vehicle or container used for collection:

- Waste collected on front-loading packer truck routes
- Waste collected in stand-alone compactors
- Waste collected in debris boxes.

B. Summary of Sampling Activity

Table 1. Sampling Activity presents the total numbers of samples collected and characterized for San Jose's residential waste study, residential recycling study, MRF study, and commercial waste study.

Table 1. Sampling Activity

Stream	Samples characterized
Residential waste	30 samples
Residential recycling	30 samples
MRF residuals	12 samples
Commercial waste	126 samples or vehicle loads

C. Coordination

Prior to the scheduled field work, consultant team members met with key staff at the City of San Jose to arrange permission and to coordinate space requirements and other logistics for the field data collection effort. The consultant team worked closely with CWS, GreenTeam, and Garden City haulers to develop a process for selecting loads of residential waste and recycling, scheduling special collection routes, and developing incentives for regular route drivers to leave behind specifically identified samples. Similarly, the consultant team worked with Allied and Stevens Creek haulers to schedule interception of commercial waste loads at the Newby Island Landfill. The consultant team also worked with the transfer station, landfill facility, and MRF personnel to coordinate space for the sorting and characterization of samples.

D. Sampling Procedures

The process of obtaining and characterizing samples was different for each waste sector. In most cases, samples were characterized by hand-sorting. However, some loads of commercial waste were better suited for visual characterization. This section provides a brief overview of characterization procedures and identifies the key differences in the way samples were obtained for each sector. The Appendix B: Detailed Study Methodology provides a more complete description of waste characterization procedures as well as the planned sample allocation and the actual numbers of samples characterized.

1. Methods of Obtaining Samples

For the characterization of residential disposed waste and residential recycled materials, the consultant team arranged for split-body trucks to visit approximately 37 to 50 households in a given service district on a given day. All the garbage that was set out by the selected households was collected in one part of the truck, while all recycling that was set out by the same households was collected in the other part of the truck. After the hauler visited selected households, the truck brought the material to the sorting location, where the consultant team sorted the amassed garbage samples and recycling samples separately.

Each sample at the MRFs was obtained by scooping up approximately 125 pounds of material from the ejection points at the MRFs and subjecting it to hand-sorting.

Most samples of commercial waste were obtained by identifying and removing a randomly-selected 200-pound sample from a selected vehicle load and then using a small loader to transport that sample to the sorting crew. In some cases, especially for debris box loads, the entire load was characterized using the visual method.

2. Hand-sort Procedure

Samples sorted by hand were sorted into 31 material categories for residential sorts, 9 material categories for MRF residual sorts, and 57 categories for commercial sorts. Each material in each category was weighed. Material that was too small to sort into distinct categories was included in the material category called Mixed Residue. The crew leaders reviewed the sorted material for homogeneity, weighed the sample components, and then recorded the weight for each sorted material category on the sampling form. A full description of the hand-sort procedure is included in Appendix B: Detailed Study Methodology.

3. Visual Characterization Procedure

In conjunction with the California Integrated Waste Management Board (CIWMB), the consultant team developed a reliable method of visually characterizing waste from the commercial waste sector. The method is especially useful for identifying recoverable materials that may be present in large quantities, characterizing waste loads that contain bulky items, and characterizing waste streams that tend to have substantial composition variation within individual loads (for example, loads that are half dirt and half lumber, separated at opposite ends of a truck).

The first step in visually estimating the composition of a selected load was to measure the volume of the waste. The visual estimator then recorded the estimated percentage of the load corresponding to each material class and then recorded the estimated percentages for specific material categories within the material classes. The procedure that the consultant team used in this study is described fully in the Appendix B: Detailed Study Methodology.

E. Data Analysis

Following the on-site data collection, the consultant team entered all data recorded on the field forms into a customized database and reviewed it for data entry errors. The team calculated waste composition estimates using the methods described in the Appendix A: Analytical Procedures section.

III. QUANTITIES OF WASTE

A. Waste Quantities

The following tables present the estimated annual tons of waste and recycling collected in San Jose. The City of San Jose provided the residential waste, residential recycling, and MRF residual tonnages for the year 2007. Additionally, the City of San Jose provided overall commercial tonnages for the year 2007, and the consultant team performed additional calculations for debris box tons based on data provided by commercial haulers Allied and Stevens Creek. See Appendix B for more details on the calculations performed. The tonnage figures for each sector or subsector were applied to composition estimates to calculate the tons of each material type present in the waste disposed by each sector or subsector.

Table 2. Annual Tons of Residential Garbage Set-outs, by District

Origin of Garbage Set-outs	Est. Annual Tons
District A	76,186
District B	30,024
District C	48,415
Total Residential Garbage Set-outs	**154,625**

Table 3. Annual Tons of Residential Recycling Set-outs, by District

Origin of Recycling Set-outs	Est. Annual Tons
District A	44,998
District B	28,355
District C	35,461
Total Residential Recycling Set-outs	**108,814**

Table 4. Annual Tons of MRF Residuals from Residential Origins, by District

Origin of Recycling Set-outs	Est. Annual Tons
District A	6,775
District B	2,429
District C	5,382
Total MRF Residential Residuals	**14,586**

Table 5. Annual Tons of Commercial Disposed Waste, by Vehicle or Container Type

Vehicle or Container Type	Est. Annual Tons
Front loaders	151,869
Compactors	44,873
Debris Boxes	5,791
Total Commercial Sector	**202,533**

Additional information of estimated weight calculations can be found in Appendix B.

IV. INTRODUCTION TO WASTE COMPOSITION RESULTS

A. Interpreting the Results

The sections below display findings for each waste stream or recycling stream using several methods of presentation, including pie charts, tables that list the most prevalent materials in each stream, and more detailed tables that show the complete composition profile of the stream.

1. Pie charts

For disposed residential and commercial waste, the pie charts in the following sections show the relative presence of key groups of recyclable or compostable materials in the stream, as well as the presence of non-recyclable materials. Recyclable materials are indicated in the pie charts with sections colored various shades of blue, while compostables are colored various shades of green. Material that is actually appropriate for disposal is represented by the red wedge in the pie charts.

Similarly, for residential recycling set-outs, key groups of recyclable materials are represented in the pie charts with various shades of blue. However, in the context of recycling operations, organic materials and non-recyclables are all considered undesirable. Those groups of materials are depicted with orange and red wedges in the pie charts for the residential recycling stream.

The pie chart for MRF residuals simply shows materials according to the broad categories that were used during the sorting process.

2. "Top Five" and "Top Ten" Tables

The analysis of residential disposed waste and commercial disposed waste includes tables showing the five or ten most prevalent recoverable or potentially recoverable materials respectively, ranked by weight, in each waste stream or substream that is considered in the study. These tables are intended to help identify the largest opportunities for additional waste diversion, recovery, or waste reduction. In the section addressing commercial disposed waste, the tables include ten material categories rather than five, because the commercial waste stream was analyzed using a more detailed material list than the residential waste stream. In most cases, the sum of all the "top" materials listed for each waste stream cumulatively represent approximately 60% or more of the entire waste stream. Thus, addressing the listed "top" materials for each waste stream could help achieve significant progress in waste reduction and recovery.

3. Composition Tables

As part of the analysis of each waste stream and substream in the sections below, a detailed composition table showing the estimated amount of each material present in the stream (expressed in terms of percents), the confidence interval surrounding each estimate (sometimes called an error range), and the estimated tons of each material that are generated or disposed annually are presented.

B. Means and Error Ranges

The data from the characterization process was treated with a statistical procedure that provided two kinds of information for each material:

- the percent-by-weight estimated composition of waste represented by the samples examined in this study, and
- the degree of precision of the composition estimates.

All estimates of precision were calculated at the 95% confidence level. The equations used in these calculations appear in Appendix A.

The example below illustrates how the results can be interpreted. The example indicates that the best estimate of the amount of *newspaper* present in the universe of waste sampled is 1.8%. The figure 0.4% reflects the precision of the estimate. When calculations are performed at the 95% confidence level, we are 95% certain that the true percent of the waste stream that is *newspaper* is between 1.8% - 0.4% and 1.8% + 0.4%. In other words, we are 95% certain that the actual amount lies between 1.4% and 2.2%.

Waste Material	**Est. Pct.**	**+ / -**
Newspaper	1.8%	0.4%

C. Rounding

When interpreting the results presented in the tables and figures in this report, it is important to consider the **effect of rounding**.

To keep the waste composition tables and figures readable, estimated tonnages are rounded to the nearest ton, and estimated percentages are rounded to the nearest tenth of a percent. Due to this rounding, the **tonnages** presented in the report, when added together, may not exactly match the subtotals and totals shown. Similarly, when the **percentages** are added together, they may not exactly match the subtotals or totals shown. Also, percentages less than 0.05% are shown as 0.0%.

V. COMPOSITION OF RESIDENTIAL WASTE

A. Summary of Findings

Disposed residential waste (i.e., single-family residential garbage set-outs) in San Jose equaled nearly 154,600 tons disposed annually, and approximately 71% of that waste stream is potentially recyclable or compostable. Approximately 52% of residential waste is compostable, consisting largely of food waste and compostable paper, and an additional 19% is recyclable or potentially recyclable.

As shown below, *organics* was the most prevalent material class for the residential waste stream by a significant amount, comprising more than half of all the waste disposed by the sector. Disposed *food waste* alone represented over 43% of the residential waste stream, and *compostable paper* in organics represented almost 7% of the residential waste stream. The second most common recyclable material class was *paper*, representing almost 10% of this waste stream. Nearly all of the paper found in the residential waste stream was recyclable or compostable. The majority of all materials found in the residential waste stream were recyclable, potentially recyclable, or compostable, as shown in Chart 1.

B. Waste Categories and Divertibility Analysis

All pie charts in this section of the report are based on the suitability of material categories for recycling or composting. In addition, the "top five" material table indicates major waste reduction opportunities for materials that are considered to be recyclable or compostable. See Appendix D: Material Definitions for a detailed list and definitions of the 31 material categories that were used.

In the residential waste study, recoverability categories included:

- **Recyclable:** This included materials for which technologies and markets exist in San Jose to recover these materials from the waste stream, through recycling or composting.
- **Compostable:** This included organic materials that are appropriate for municipal composting programs.
- **Potentially Recyclable:** This included materials for which methods and/or technology exist for recycling, reuse, or other beneficial uses, although programs to collect and process the materials are not readily available the San Jose area.
- **Non-Recyclable:** This included materials that do not fit any of the definitions above and that are not easily diverted from disposal. This includeed materials for which technologies and markets have not been adequately developed to permit recovery of these materials from the waste stream.

Table 6 shows the residential material types grouped according to these recoverability categories.

Table 6. Residential Recoverability

Recyclable	Compostable
#1 PET Bottles and Containers	Compostable Paper
#2 HDPE Bottles and Containers	Food Waste
#3, #4, #5 and #7 Bottles and Containers	Yard Waste
Aluminum Beverage Cans	**Potentially Recyclable**
Aluminum Foil	Automotive Batteries
Durable Plastic	Electronics
Mixed Papers	Oil Filters
Newspaper	Tanks
OCC	Tires
Other Scrap Metal	TVs and CRT Monitors
Plastic Bags and Other Film	Wood
Polystyrene	**Non-Recyclable**
Recyclable Glass	Other Glass
Steel (Tin) Cans	Other Metal
Textiles	Other Paper
	Other Plastic
	Non-Recyclable

C. Residential Waste Aggregate Results

To characterize the residential disposed waste stream, waste from more than 1,270 households was collected, aggregated, and sorted in the study period in order to characterize the 154,000 tons of residential waste disposed of in the City of San Jose annually. Citywide residential waste composition findings, as well as findings for each district, are presented in three ways:

- A summary of waste composition by recoverability category is presented in a pie chart.
- The five most prevalent material types, by weight, are shown in a table.
- A detailed table lists the full composition and quantity results for the 31 material types.

Chart 1 illustrates composition estimates by recoverability category for the overall residential waste stream. Approximately 70% of this waste was estimated to be recyclable, potentially recyclable, or compostable.

Chart 1. Recoverability of Materials in Overall Residential Disposed Waste

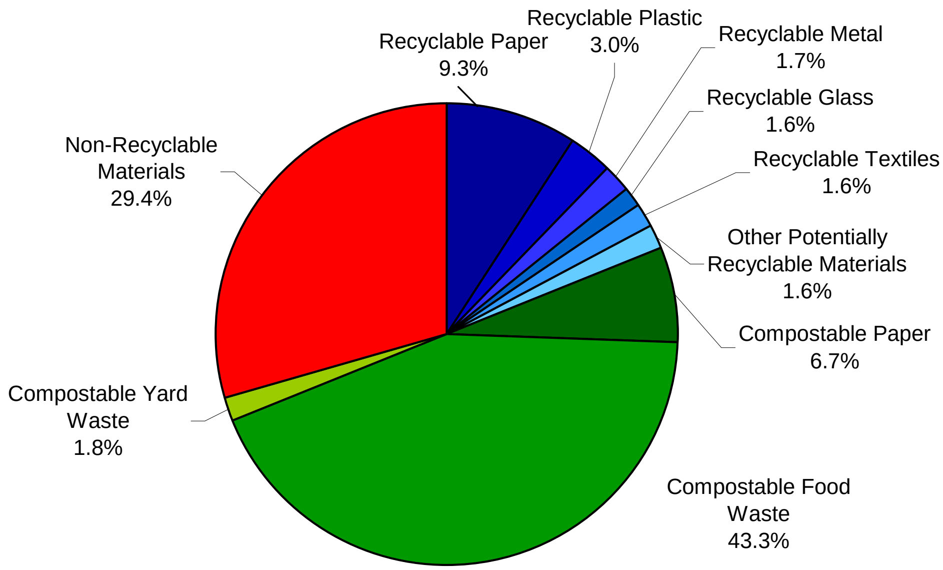


Table 7 shows the top five most prevalent recoverable materials found in overall residential disposed waste. The top five recoverable materials together represent more than 60% of residential waste.

Table 7. Overall Residential Waste Top Five Most Prevalent Recoverables

Waste Material	Mean	Cum. %	Tons
Food Waste	43.3%	43.3%	66,956
Mixed Papers	6.9%	50.2%	10,698
Compostable Paper	6.7%	56.9%	10,295
Yard Waste	1.8%	58.7%	2,787
Newspaper	1.8%	60.5%	2,737
Subtotal	**60.5%**		**93,473**
All other materials combined	39.5%		61,152
Total	**100%**		**154,625**

Table 8, below, presents a detailed tabular summary of the aggregate residential waste stream composition. The table shows the calculated percentages of each material and material class as a percentage of the whole, as well as confidence intervals and estimated annual tons associated with the disposal of each material.

Table 8. Overall Residential Waste Composition

Material	Est. %	+/-	Est. Tons
Paper	**9.8%**		**15,178**
Mixed Papers	6.9%	0.5%	10,698
Newspaper	1.8%	0.4%	2,737
OCC	0.6%	0.1%	926
Other Paper	0.5%	0.1%	817
Plastic	**4.0%**		**6,129**
#1 PET Bottles and Containers	0.6%	0.1%	947
#2 HDPE Bottles and Containers	0.5%	0.0%	713
#3, #4, #5 and #7 Bottles and Containers	0.6%	0.1%	878
Durable Plastic	0.6%	0.1%	941
Plastic Bags and Other Film	0.1%	0.0%	207
Polystyrene	0.7%	0.1%	1,011
Other Plastic	0.9%	0.1%	1,433
Metal	**2.3%**		**3,622**
Aluminum Beverage Cans	0.2%	0.1%	309
Aluminum Foil	0.3%	0.0%	387
Steel (Tin) Cans	0.8%	0.1%	1,231
Other Scrap Metal	0.5%	0.1%	738
Other Metal	0.6%	0.2%	958
Glass	**1.9%**		**2,937**
Recyclable Glass	1.6%	0.2%	2,430
Other Glass	0.3%	0.1%	507
Organic Materials	**51.8%**		**80,038**
Compostable Paper	6.7%	0.5%	10,295
Food Waste	43.3%	2.1%	66,956
Yard Waste	1.8%	0.5%	2,787
Textiles	**1.6%**	**0.3%**	**2,469**
Other Materials	**1.6%**		**2,502**
Automotive Batteries	0.1%	0.1%	121
Electronics	0.1%	0.1%	173
Oil Filters	0.0%	0.0%	11
Tanks	0.0%	0.0%	7
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	0.9%	0.4%	1,460
Other Universal Waste	0.5%	0.5%	730
Non-recyclable Materials	**27.0%**	**1.9%**	**41,748**
Total	**100.0%**		**154,625**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

D. *Residential Waste Results by District*

The following three sections present composition findings for the City of San Jose's residential disposed waste stream by collection district. For disposed waste, findings for the three districts were similar.

1. Residential Waste – District A

Chart 2. Recoverability of Materials in District A Residential Disposed Waste

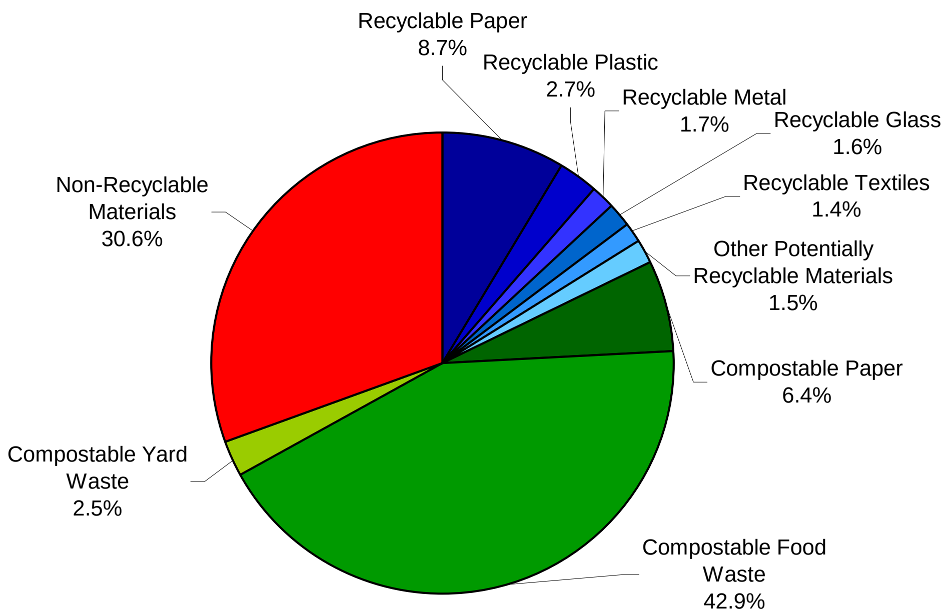


Table 9. Residential Waste District A, Top Five Most Prevalent Recoverables

Waste Material	Mean	Cum. %	Tons
Food Waste	42.9%	42.9%	32,665
Mixed Papers	6.8%	49.7%	5,163
Compostable Paper	6.4%	56.1%	4,909
Yard Waste	2.5%	58.6%	1,883
Recyclable Glass	1.6%	60.1%	1,183
Subtotal	**60.1%**		**45,803**
All other materials combined	39.9%		30,383
Total	**100%**		**76,186**

Table 10. Residential Waste District A Composition

Material	Est. %	+/-	Est. Tons
Paper	**9.3%**		**7,101**
Mixed Papers	6.8%	1.0%	5,163
Newspaper	1.5%	0.5%	1,132
OCC	0.5%	0.3%	369
Other Paper	0.6%	0.4%	437
Plastic	**3.6%**		**2,713**
#1 PET Bottles and Containers	0.5%	0.2%	375
#2 HDPE Bottles and Containers	0.4%	0.1%	319
#3, #4, #5 and #7 Bottles and Containers	0.5%	0.1%	359
Durable Plastic	0.5%	0.1%	353
Plastic Bags and Other Film	0.1%	0.1%	102
Polystyrene	0.7%	0.1%	546
Other Plastic	0.9%	0.1%	657
Metal	**2.6%**		**1,969**
Aluminum Beverage Cans	0.2%	0.2%	171
Aluminum Foil	0.2%	0.0%	162
Steel (Tin) Cans	0.8%	0.2%	608
Other Scrap Metal	0.5%	0.2%	372
Other Metal	0.9%	0.5%	657
Glass	**1.9%**		**1,474**
Recyclable Glass	1.6%	0.4%	1,183
Other Glass	0.4%	0.2%	290
Organic Materials	**51.8%**		**39,457**
Compostable Paper	6.4%	1.1%	4,909
Food Waste	42.9%	3.9%	32,665
Yard Waste	2.5%	1.4%	1,883
Textiles	**1.4%**	**0.7%**	**1,090**
Other Materials	**1.5%**		**1,134**
Automotive Batteries	0.0%	0.0%	0
Electronics	0.0%	0.0%	16
Oil Filters	0.0%	0.0%	6
Tanks	0.0%	0.0%	0
Tires	0.0%	0.0%	0
TVs and CRT Monitors	0.0%	0.0%	0
Wood	0.7%	0.8%	505
Other Universal Waste	0.8%	1.3%	607
Non-recyclable Materials	**27.9%**	**4.1%**	**21,249**
Total	**100.0%**		**76,186**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

2. Residential Waste – District B

Chart 3. Recoverability of Materials in District B Residential Disposed Waste

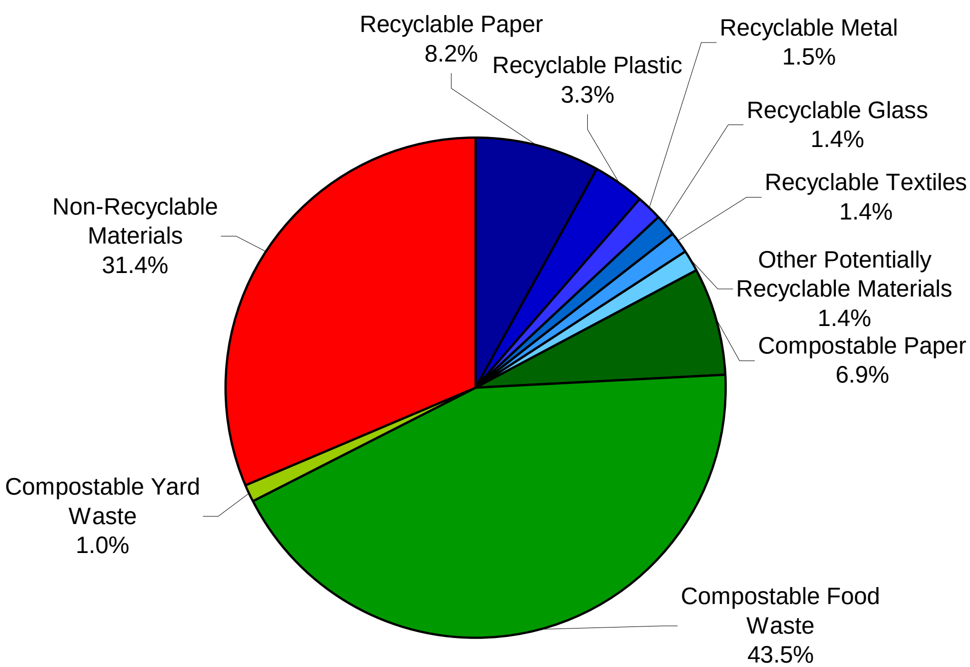


Table 11. Residential Waste District B, Top Five Most Prevalent Recoverables

Waste Material	Mean	Cum. %	Tons
Food Waste	43.5%	43.5%	13,062
Compostable Paper	6.9%	50.4%	2,059
Mixed Papers	6.2%	56.6%	1,863
Textiles	1.4%	58.0%	435
Recyclable Glass	1.4%	59.4%	424
Subtotal	**59.4%**		**17,843**
All other materials combined	40.6%		12,181
Total	**100%**		**30,024**

Table 12. Residential Waste District B Composition

Material	Est. %	+/-	Est. Tons
Paper	**8.7%**		**2,613**
Mixed Papers	6.2%	1.1%	1,863
Newspaper	1.3%	0.4%	396
OCC	0.6%	0.3%	194
Other Paper	0.5%	0.2%	160
Plastic	**4.4%**		**1,331**
#1 PET Bottles and Containers	0.7%	0.2%	207
#2 HDPE Bottles and Containers	0.5%	0.1%	139
#3, #4, #5 and #7 Bottles and Containers	0.7%	0.2%	198
Durable Plastic	0.7%	0.3%	221
Plastic Bags and Other Film	0.1%	0.1%	38
Polystyrene	0.6%	0.2%	182
Other Plastic	1.2%	0.9%	346
Metal	**2.0%**		**594**
Aluminum Beverage Cans	0.2%	0.1%	53
Aluminum Foil	0.2%	0.0%	66
Steel (Tin) Cans	0.7%	0.2%	212
Other Scrap Metal	0.4%	0.3%	119
Other Metal	0.5%	0.3%	144
Glass	**1.7%**		**516**
Recyclable Glass	1.4%	0.7%	424
Other Glass	0.3%	0.2%	92
Organic Materials	**51.4%**		**15,424**
Compostable Paper	6.9%	0.9%	2,059
Food Waste	43.5%	4.5%	13,062
Yard Waste	1.0%	0.9%	303
Textiles	**1.4%**	**0.8%**	**435**
Other Materials	**1.4%**		**412**
Automotive Batteries	0.4%	0.9%	121
Electronics	0.2%	0.2%	46
Oil Filters	0.0%	0.0%	-
Tanks	0.0%	0.0%	-
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	0.7%	0.5%	205
Other Universal Waste	0.1%	0.1%	41
Non-recyclable Materials	**29.0%**	**6.0%**	**8,699**
Total	**100.0%**		**30,024**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

3. Residential Waste – District C

Chart 4. Recoverability of Materials in District C Residential Disposed Waste

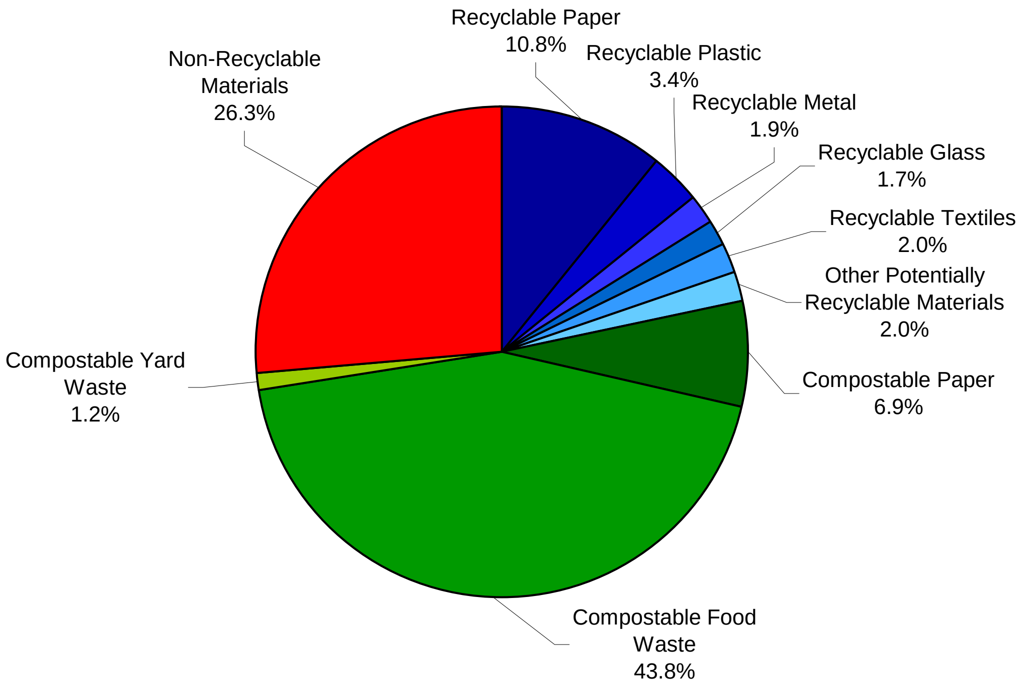


Table 13. Residential Waste District C, Top Five Most Prevalent Recoverables

Waste Material	Mean	Cum. %	Tons
Food Waste	43.8%	43.8%	21,229
Mixed Papers	7.6%	51.4%	3,672
Compostable Paper	6.9%	58.3%	3,326
Newspaper	2.5%	60.8%	1,209
Textiles	2.0%	62.8%	945
Subtotal	**62.8%**		**30,381**
All other materials combined	37.2%		18,034
Total	**100%**		**48,415**

Table 14. Residential Waste District C Composition

Material	Est. %	+/-	Est. Tons
Paper	**11.3%**		**5,464**
Mixed Papers	7.6%	1.2%	3,672
Newspaper	2.5%	1.3%	1,209
OCC	0.8%	0.4%	363
Other Paper	0.5%	0.2%	220
Plastic	**4.3%**		**2,086**
#1 PET Bottles and Containers	0.8%	0.2%	365
#2 HDPE Bottles and Containers	0.5%	0.1%	255
#3, #4, #5 and #7 Bottles and Containers	0.7%	0.2%	321
Durable Plastic	0.8%	0.2%	366
Plastic Bags and Other Film	0.1%	0.1%	67
Polystyrene	0.6%	0.1%	283
Other Plastic	0.9%	0.1%	430
Metal	**2.2%**		**1,060**
Aluminum Beverage Cans	0.2%	0.1%	85
Aluminum Foil	0.3%	0.1%	159
Steel (Tin) Cans	0.9%	0.2%	412
Other Scrap Metal	0.5%	0.3%	247
Other Metal	0.3%	0.3%	157
Glass	**2.0%**		**947**
Recyclable Glass	1.7%	0.4%	823
Other Glass	0.3%	0.1%	124
Organic Materials	**52.0%**		**25,157**
Compostable Paper	6.9%	1.4%	3,326
Food Waste	43.8%	5.8%	21,229
Yard Waste	1.2%	0.7%	602
Textiles	**2.0%**	**0.9%**	**945**
Other Materials	**2.0%**		**956**
Automotive Batteries	0.0%	0.0%	-
Electronics	0.2%	0.2%	111
Oil Filters	0.0%	0.0%	5
Tanks	0.0%	0.0%	7
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	1.5%	1.2%	750
Other Universal Waste	0.2%	0.1%	83
Non-recyclable Materials	**24.4%**	**3.6%**	**11,800**
Total	**100.0%**		**48,415**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

VI. COMPOSITION OF RESIDENTIAL RECYCLING

A. Summary of Findings

Recyclables were sorted in order to characterize the 108,000 tons of residential recycling set-outs that are collected annually in the City of San Jose. Approximately 25% of this material stream consisted of non-recyclable materials (i.e., contaminants) that were not desired by MRF operators. Besides contaminants, paper was the most prevalent material class for the residential recycling stream by a significant amount, comprising more than half of all the waste disposed by the sector. Mixed paper alone represented over 26% of the residential recycling stream. The next most common material classes were glass at 9% and plastic at 8%.

For the purpose of this study, everything that is not listed as a recyclable material is shown in the pie chart below as “non-recyclable” or “compostable.”

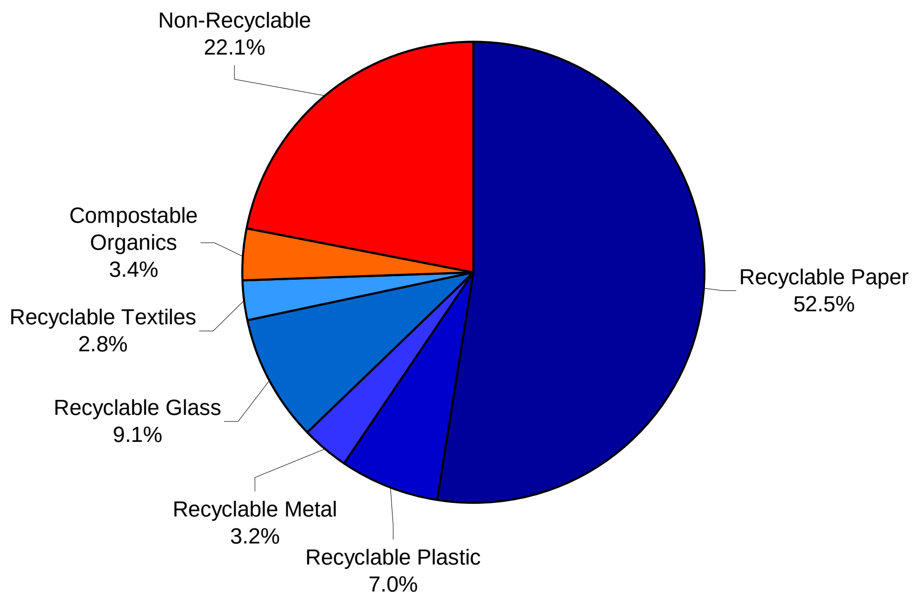
B. Residential Recycling Aggregate Results

Residential recycling results for overall recycling, as well as recycling for each district, are presented in two ways:

- A summary of recycling composition by recoverability category is presented in a pie chart.
- A detailed table lists the full composition and quantity findings for the 31 material types.

Chart 5 illustrates composition estimates by recoverability category for the overall residential recycling stream. Approximately 25% of this recycling stream was estimated to be contaminants (non-recyclable and organics).

Chart 5. Citywide Composition of Residential Recycling Set-outs, by Recoverability Category



Detailed residential recycling composition findings are presented in Table 15, below. The table shows the calculated percentages of each material and material class as a percentage of the whole, as well as confidence intervals and estimated annual tons for each material.

Table 15. Overall Residential Recycling Composition

Material	Est. %	+/-	Est. Tons
Paper	**53.2%**		**57,893**
Mixed Papers	26.4%	2.2%	28,714
Newspaper	16.0%	1.7%	17,460
OCC	10.1%	1.2%	10,957
Other Paper	0.7%	0.3%	762
Plastic	**7.9%**		**8,594**
#1 PET Bottles and Containers	2.0%	0.2%	2,151
#2 HDPE Bottles and Containers	1.9%	0.2%	2,026
#3, #4, #5 and #7 Bottles and Containers	0.7%	0.1%	789
Durable Plastic	1.5%	0.2%	1,581
Plastic Bags and Other Film	0.4%	0.1%	460
Polystyrene	0.5%	0.2%	563
Other Plastic	0.9%	0.2%	1,024
Metal	**4.1%**		**4,428**
Aluminum Beverage Cans	0.3%	0.1%	332
Aluminum Foil	0.1%	0.0%	72
Steel (Tin) Cans	1.3%	0.2%	1,411
Other Scrap Metal	1.5%	0.6%	1,671
Other Metal	0.9%	0.3%	942
Glass	**9.4%**		**10,225**
Recyclable Glass	9.1%	0.8%	9,894
Other Glass	0.3%	0.1%	331
Organic Materials	**3.4%**		**3,676**
Compostable Paper	0.5%	0.2%	598
Food Waste	2.2%	1.3%	2,340
Yard Waste	0.7%	0.5%	738
Textiles	**2.8%**	**1.0%**	**3,057**
Other Materials	**2.2%**		**2,432**
Automotive Batteries	0.0%	0.0%	-
Electronics	0.3%	0.2%	339
Oil Filters	0.0%	0.0%	7
Tanks	0.1%	0.2%	133
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	1.0%	0.4%	1,103
Other Universal Waste	0.8%	1.0%	851
Non-recyclable Materials	**17.0%**	**2.0%**	**18,508**
Total	**100.0%**		**108,814**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

C. Residential Recycling Results by District

The following three sections present the City of San Jose's residential recycling stream by district. District A recycling set-outs on the whole had more non-recyclable materials and more organics than Districts B and C, while District C recycled relatively more glass than the other districts.

1. Residential Recycling – District A

Chart 6. Composition of Residential Recycling Set-outs, District A, by Recoverability Category

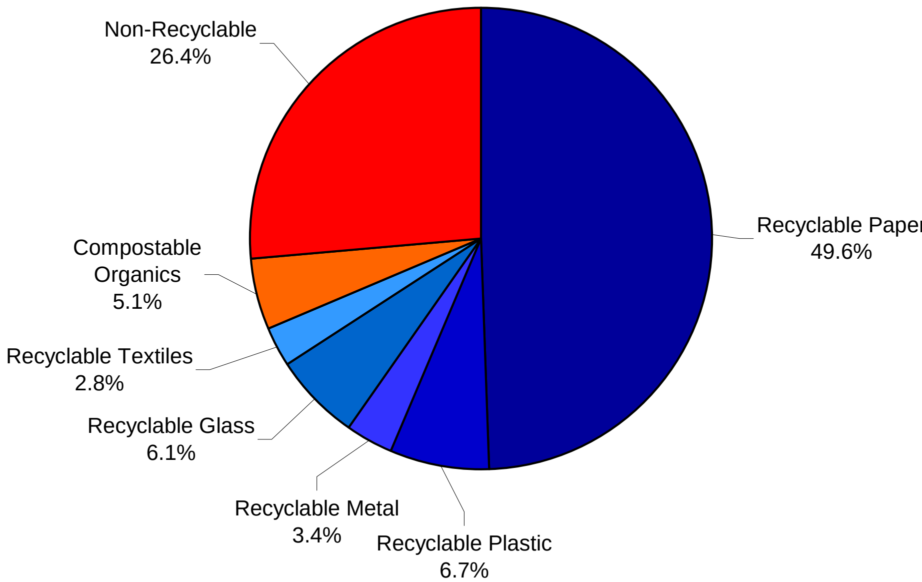


Table 16. Residential Recycling District A Composition

Material	Est. %	+/-	Est. Tons
Paper	**50.0%**		**22,520**
Mixed Papers	24.8%	6.0%	11,174
Newspaper	14.6%	3.7%	6,555
OCC	10.2%	3.2%	4,582
Other Paper	0.5%	0.3%	209
Plastic	**8.0%**		**3,579**
#1 PET Bottles and Containers	1.5%	0.3%	673
#2 HDPE Bottles and Containers	2.0%	0.4%	913
#3, #4, #5 and #7 Bottles and Containers	0.6%	0.2%	275
Durable Plastic	1.4%	0.2%	645
Plastic Bags and Other Film	0.4%	0.2%	194
Polystyrene	0.7%	0.6%	324
Other Plastic	1.2%	0.4%	554
Metal	**4.6%**		**2,056**
Aluminum Beverage Cans	0.2%	0.1%	82
Aluminum Foil	0.0%	0.0%	22
Steel (Tin) Cans	1.2%	0.5%	550
Other Scrap Metal	1.9%	1.7%	864
Other Metal	1.2%	0.9%	540
Glass	**6.5%**		**2,938**
Recyclable Glass	6.1%	1.2%	2,733
Other Glass	0.5%	0.4%	205
Organic Materials	**5.1%**		**2,273**
Compostable Paper	0.6%	0.6%	272
Food Waste	3.4%	4.1%	1,543
Yard Waste	1.0%	1.4%	458
Textiles	**2.8%**	**1.5%**	**1,252**
Other Materials	**2.5%**		**1,122**
Automotive Batteries	0.0%	0.0%	-
Electronics	0.3%	0.3%	139
Oil Filters	0.0%	0.0%	-
Tanks	0.3%	0.5%	133
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	1.6%	1.0%	722
Other Universal Waste	0.3%	0.5%	129
Non-recyclable Materials	**20.6%**	**3.9%**	**9,258**
Total	**100.0%**		**44,998**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

2. Residential Recycling – District B

Chart 7. Composition of Residential Recycling Set-outs, District B, by Recoverability Category

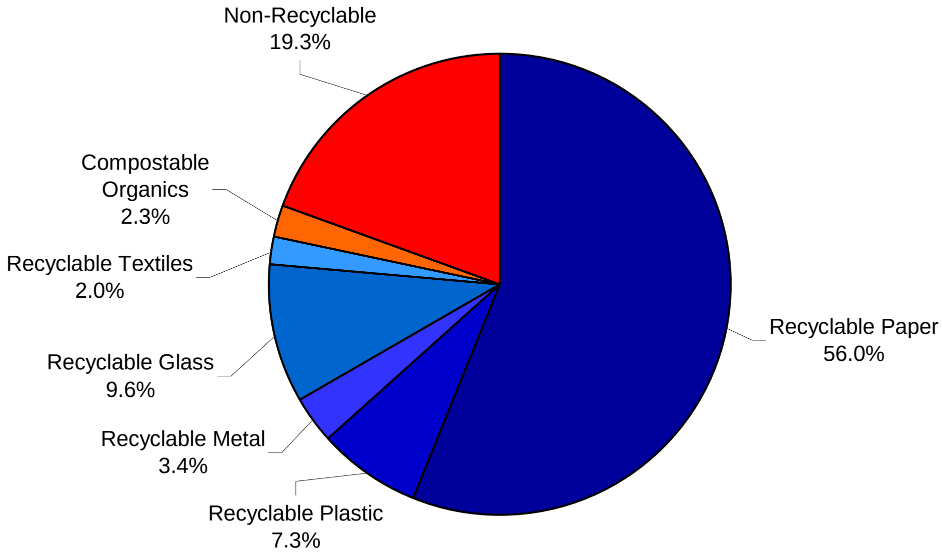


Table 17. Residential Recycling District B Composition

Material	Est. %	+/-	Est. Tons
Paper	**56.7%**		**16,080**
Mixed Papers	30.1%	5.0%	8,527
Newspaper	17.2%	5.0%	4,865
OCC	8.8%	2.0%	2,499
Other Paper	0.7%	0.6%	190
Plastic	**8.2%**		**2,338**
#1 PET Bottles and Containers	2.4%	0.7%	691
#2 HDPE Bottles and Containers	1.7%	0.3%	493
#3, #4, #5 and #7 Bottles and Containers	0.7%	0.2%	200
Durable Plastic	1.5%	0.8%	429
Plastic Bags and Other Film	0.6%	0.3%	170
Polystyrene	0.3%	0.1%	96
Other Plastic	0.9%	0.6%	258
Metal	**3.9%**		**1,108**
Aluminum Beverage Cans	0.2%	0.1%	67
Aluminum Foil	0.1%	0.1%	31
Steel (Tin) Cans	1.4%	0.3%	411
Other Scrap Metal	1.6%	1.2%	457
Other Metal	0.5%	0.3%	143
Glass	**9.8%**		**2,765**
Recyclable Glass	9.6%	2.1%	2,713
Other Glass	0.2%	0.1%	53
Organic Materials	**2.3%**		**659**
Compostable Paper	0.5%	0.4%	148
Food Waste	1.6%	1.1%	450
Yard Waste	0.2%	0.3%	61
Textiles	**2.0%**	**2.0%**	**565**
Other Materials	**3.6%**		**1,016**
Automotive Batteries	0.0%	0.0%	-
Electronics	0.6%	0.7%	164
Oil Filters	0.0%	0.0%	-
Tanks	0.0%	0.0%	-
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	0.5%	0.7%	155
Other Universal Waste	2.5%	5.2%	697
Non-recyclable Materials	**13.5%**	**7.1%**	**3,823**
Total	**100.0%**		**28,355**

Confidence intervals calculated at 95% confidence level.

Materials such as "other paper," "other glass," "other metal," and "food waste" are not recyclable at the present time in San Jose.

3. Residential Recycling – District C

Chart 8. Composition of Residential Recycling Set-outs, District C, by Recoverability Category

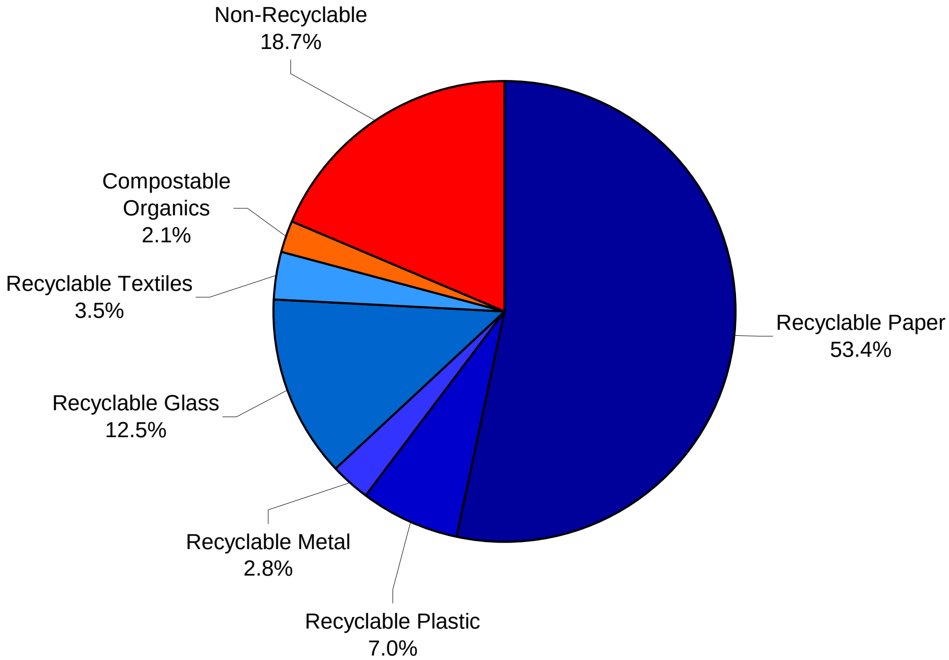


Table 18. Residential Recycling District C Composition

Material	Est. %	+/-	Est. Tons
Paper	**54.4%**		**19,293**
Mixed Papers	25.4%	3.2%	9,013
Newspaper	17.0%	2.9%	6,040
OCC	10.9%	2.6%	3,876
Other Paper	1.0%	1.1%	363
Plastic	**7.5%**		**2,677**
#1 PET Bottles and Containers	2.2%	0.4%	786
#2 HDPE Bottles and Containers	1.7%	0.5%	619
#3, #4, #5 and #7 Bottles and Containers	0.9%	0.4%	313
Durable Plastic	1.4%	0.6%	507
Plastic Bags and Other Film	0.3%	0.1%	96
Polystyrene	0.4%	0.1%	144
Other Plastic	0.6%	0.3%	212
Metal	**3.6%**		**1,264**
Aluminum Beverage Cans	0.5%	0.2%	184
Aluminum Foil	0.1%	0.0%	19
Steel (Tin) Cans	1.3%	0.3%	451
Other Scrap Metal	1.0%	0.7%	351
Other Metal	0.7%	0.4%	259
Glass	**12.8%**		**4,522**
Recyclable Glass	12.5%	2.2%	4,448
Other Glass	0.2%	0.2%	74
Organic Materials	**2.1%**		**745**
Compostable Paper	0.5%	0.3%	178
Food Waste	1.0%	0.8%	347
Yard Waste	0.6%	1.0%	220
Textiles	**3.5%**	**3.2%**	**1,241**
Other Materials	**0.8%**		**293**
Automotive Batteries	0.0%	0.0%	-
Electronics	0.1%	0.1%	36
Oil Filters	0.0%	0.0%	7
Tanks	0.0%	0.0%	-
Tires	0.0%	0.0%	-
TVs and CRT Monitors	0.0%	0.0%	-
Wood	0.6%	0.5%	226
Other Universal Waste	0.1%	0.1%	24
Non-recyclable Materials	**15.3%**	**3.3%**	**5,427**
Total	**100.0%**		**35,461**

Confidence intervals calculated at 95% confidence level.

Materials such as “other paper,” “other glass,” “other metal,” and “food waste” are not recyclable at the present time in San Jose.

VII. MRF RESIDUE FROM THE PROCESSING OF RECYCLABLES STUDY

A. Summary of Findings

In the *MRF stream*, 12 residual samples were sorted in the study period in order to characterize the 14,000 tons of MRF residuals processed in the City of San Jose annually. Residual materials from the processing of recyclables were sampled at the GreenTeam MRF and the CWS MRF. Sampled materials were residuals from the processing of recyclables that originated from single-family residences in each of the three collection districts. A total of more than 1,500 pounds of residuals from 12 samples was sorted from residual materials. Four samples were collected representing District B, and eight samples were collected representing combined residuals from Districts A and C.

Approximately two-thirds of the scrap metal and textiles in MRF residuals could be recovered for recycling. Approximately 10% of the materials currently being discarded as residuals from the MRF processing operations would likely still be landfilled. This would include the PVC and some Other Plastics, some Mixed Metal items, some of the Textiles, and some of the Other Materials category.

Over 80% of the materials being disposed of as residuals from the two Residential Recyclables Processing Facilities used by the City's contractors have energy value. About half of the residuals with energy value are compostable or digestible. Plastics are not compostable or digestible, and their energy could best be recovered through direct or indirect combustion.

If a combustion technology was applied to the entire MRF residuals stream, with an estimated energy value of 5,000 BTUs per pound of combustible material, and with an estimated 13,164 pounds per year of MRF residuals that are combustible, approximately 65.8 million BTUs potentially could be produced annually.

B. Waste Categories

The nine material categories included in the MRF residuals study were Film Plastics, Other/Rigid Plastics, Dimensional Wood, Plant Trimmings, Paper, Textiles, Ferrous Metals, Miscellaneous Organics, and All Other Material. See Appendix D: Material Definitions for detailed definitions of the nine materials that were considered.

C. MRF Results

MRF residual results are presented in the following ways:

- For the overall MRF study, a summary of composition is presented in a pie chart. Unlike the previous pie charts for the residential sort that presented information according to recoverability, the MRF pie chart presents its findings organized by material class.
- For the overall MRF study, as well as for both of the processing facilities, detailed tables present the full composition and quantity results for the nine material types.

1. Aggregate Results – Overall Residue from Processing of Residential Recyclables

Chart 9 and Table 19, below, present detailed composition findings for MRF residential residuals. Estimated tons in the tables were extrapolated based on annual waste tonnages provided by the City.

Chart 9. Materials in MRF Residential Residuals Stream, Citywide

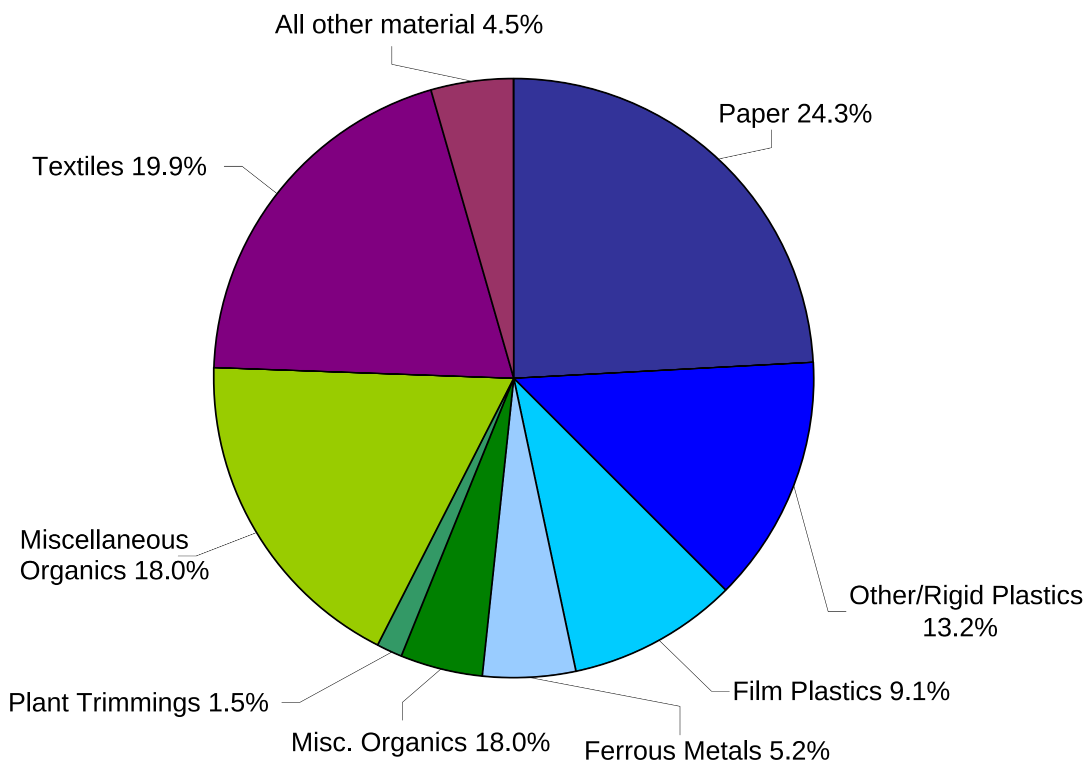


Table 19. Composition of Residue from Processing of Recyclables – Overall[1]

Material	Est. %	Est. Tons
Paper	24.3%	3,541
Other/Rigid Plastics	13.2%	1,922
Film Plastics	9.1%	1,329
Ferrous Metals	5.2%	759
Dimensional Wood	4.3%	623
Plant Trimmings	1.5%	222
Miscellaneous Organics	18.0%	2,627
Textiles	19.9%	2,900
All other material	4.5%	663
Total	**100.0%**	**14,587**

[1] Aggregate composition data for MRF study is weighted by district.

2. Composition Results – Districts A & C Residue from Processing of Recyclables

Table 20. Composition of Residue from Processing of Residential Recyclables, Districts A & C

Material	Est. %	Est. Tons
Paper	23.7%	2,887
Other/Rigid Plastics	11.4%	1,390
Film Plastics	9.4%	1,138
Ferrous Metals	5.5%	674
Dimensional Wood	5.0%	614
Plant Trimmings	1.4%	167
Miscellaneous Organics	17.1%	2,079
Textiles	22.8%	2,767
All other material	3.6%	440
Total	**100.0%**	**12,158**

- Paper and textiles were the primary components of the residuals from the CWS MRF in Districts A and C. Most of the paper was small pieces, especially shredded paper and bulk mail. Textiles were comprised of both clothing and stuffed animals. The samples from Districts A and C showed that:
- Most of the paper was paperboard packaging, bulk mail, and shredded paper.
- Most of the textiles were clothing and stuffed animals.
- Miscellaneous Organics were comprised of food wastes, disposable diapers, and (food and pet) soiled paper not suitable for recycling at the point of generation.
- Other Rigid Plastics and Film Plastics were a significant percentage of the volume, but a lower percentage by weight. Visually, the Film Plastics seemed to dominate the surface of the sample. Many of the plastic bags were in the MRF residuals because they were used to contained recyclables at the curbside set-out.
- Scrap Metal in the residuals was often wire or metal in combination with other materials. A few cans were missed by the ferrous magnets.
- Wood scraps were mostly pieces of furniture. Wicker furniture and baskets were common in the MRF residuals samples.
- Plant Trimmings were most often indoor flower arrangements and house plants.
- Other Materials were container and plate glass, as well as inerts (such as rock and brick).

3. Composition Results – District B Residue from Processing of Recyclables

Table 21. Composition of Residue from Processing of Residential Recyclables, District B

Material	Est. %	Est. Tons
Paper	26.9%	655
Other/Rigid Plastics	21.9%	532
Film Plastics	7.9%	191
Ferrous Metals	3.5%	85
Dimensional Wood	0.4%	9
Plant Trimmings	2.3%	55
Miscellaneous Organics	22.5%	548
Textiles	5.5%	133
All other material	9.2%	223
Total	**100.0%**	**2,429**

- Paper, Miscellaneous Organics and Rigid Plastics were the major components of residential residuals from District B at the GreenTeam MRF. One of the samples included a significant amount of All Other Materials in the form of sheetrock and other construction materials. The samples from District B show that:
- Paper, Miscellaneous Organics, and Other Rigid Plastics were the three major components of the District B residuals.
- One of the samples included a significant amount of sheetrock and other construction materials, which are in the All Other Materials category. Only a small amount of All Other Materials was found in any other sample.
- Most of the paper was paperboard packaging, bulk mail, and shredded paper.
- The textiles were clothing, linens, curtains, and stuffed animals.
- Most of the Miscellaneous Organics were food wastes, disposable diapers, and (food and pet) soiled paper not suitable for recycling at the point of generation.
- Other Rigid Plastics primarily included plastic containers, block foam, and other packaging.

4. Comparisons between Districts A and C and District B residuals

- Paper was the largest component of residuals from both processing facilities. Most of the paper was paperboard packaging, but there were significant amounts of shredded paper and mail that had not been shredded.
- There was more film plastic in the Districts A and C residuals than in the District B residuals.
- Relatively more shredded paper was found in the samples from District B.
- Although residuals from all districts contained textiles, the residuals from Districts A and C contained relatively more dirty textiles, stuffed animals, and worn tennis shoes.

D. Projected Energy Value

Energy can be derived from the residual materials by burning them directly, heating them in the absence of oxygen to produce a liquid or gaseous fuel which can be burned for energy, or digesting them in the absence of oxygen to produce methane that can be burned for its energy value.

1. Direct Incineration: Paper, Plastics (other than PVC), Wood, Compostable Organics, and Plant Trimmings can all be burned for their fuel value. If this takes place in the presence of heat and oxygen, the materials are directly combusted. Approximately 80% of the MRF residuals can be incinerated for energy recovery.

   The three primary drawbacks to direct incineration include:
   - drying the compostable organics and plant trimmings first
   - managing chlorine gas generated when PVC plastics (#3) are burned
   - managing the air quality impacts of burning mixed materials.

2. Distillation: These same materials can all be heated in the absence of oxygen to produce a liquid or gaseous fuel that could be combusted in the presence of oxygen (possibly in another location). Many technologies can be used to convert these materials to energy, including pyrolysis (for example Imperial Petroleum Recovery Corporation, http://www.iprc.com/index.php), P-Fuel (http://www.p-fuel.com), and Microwave Energy Recovery Technology (for example, see Global Resource Corporation, http://www.globalresourcecorp.com). Approximately 80% of the MRF residuals can be processed into fuel.

3. Digestion with Methane Recovery: Paper, Plant Trimmings, Wood, and Compostable Organics can all be digested at low temperature and in the absence of oxygen to generate methane. Since this is done in an enclosed chamber to keep the oxygen out, the methane that is generated can be recovered for use as a fuel source.

Digestion does not recover the energy from plastics, so the plastic components of the MRF residue would have to be processed separately. Approximately 40% of the MRF residuals can be digested to produce methane. An additional 40% primarily plastics could then be incinerated or processed for fuel.

Approximately 10% of the materials currently being discarded as residuals from the MRF processing operations would likely still be landfilled. This would include the PVC plastics and some other Plastics, some mixed Metal items, some of the Textiles, and some of the Other Materials.

Table 22. Energy Composition of MRF Residuals – Districts A & C

	Est. %	% combustible	% compostable or digestible	post compost % combustible	% recyclable	% of residue to be landfilled
Paper	23.70%	23.70%	23.70%			
Other Plastics	11.40%	11.40%		11.40%		PVC
Film Plastics	9.40%	9.40%		9.40%		
Metals	5.50%				3.30%	2.20%
Wood	5.00%	5.00%		5.00%		
Plant Trimmings	1.40%	1.40%	1.40%			
Miscellaneous Organics	17.10%	17.10%	17.10%			
Textiles	22.80%	14.80%		14.80%	5.70%	2.30%
Other Materials	3.60%				1.80%	1.80%
TOTALS	**99.90%**	**82.80%**	**42.20%**	**40.60%**	**10.80%**	**6.30%**

Table 23. Energy Composition of MRF Residuals – District B

	Est. %	% combustible	% compostable or digestible	post compost % combustible	% recyclable	% of residue to be landfilled
Paper	26.90%	26.90%	26.90%			
Other Plastics	21.90%	21.90%		21.90%		PVC
Film Plastics	7.90%	7.90%		7.90%		
Metals	3.50%				2.10%	1.40%
Wood	0.40%	0.40%		0.40%		
Plant Trimmings	2.30%	2.30%	2.30%			
Miscellaneous Organics	22.50%	22.50%	22.50%			
Textiles	5.50%	3.60%		3.60%	1.40%	0.60%
Other Materials	9.20%				4.60%	4.60%
TOTALS	**100.10%**	**85.50%**	**51.70%**	**33.80%**	**8.10%**	**6.60%**

The following tables are included to provide some background on the potential energy value of the residuals from the MRFs. The actual energy value would be determined by the process used.

Table 24. Heating Values of Plastics and Various Materials[2]

Material Heating Value	MJ/kg	BTU/lb
Fuel Oil	48.6	20,900
Polyethylene	46.3	19,900
Polypropylene	44.1	19,000
Polystyrene	41.4	17,800
Tires	30.1	13,000
Sub-Bituminous Coal	27.3	11,700
Wood (pine)	22.3	9,600
Wood (oak)	19.3	8,300
Municipal Solid Waste (dry)	16.2	7,000
Municipal Solid Waste (50% moisture)	7.9	3,400

Table 25. Heat of Combustion for Common Fuels[3]

Fuel	MJ/kg	Mcal/kg	BTU/lb
Hydrogen	141.9	33.9	61,000
Gasoline	47	11.3	20,400
Diesel	45	10.7	19,300
Ethanol	29.8	7.1	12,800
Propane	49.9	11.9	21,500
Butane	49.2	11.8	21,200
Wood	15	3.6	6,500
Coal	15–27	4.4–7.8	8,000–14,000
Natural Gas	~54	~13	~23,000

Based on these tables, the MRF residuals might generate about 5,000 BTU per pound of residuals.

[2] Source: Garthe and Kowal, 1993; and Gupta and Lilley, 2003

[3] Source: National Energy Education Development Project, Museum of Solid Waste, 2006

VIII. COMMERCIAL STUDY

A. Summary of Findings

Disposed commercial waste in San Jose equaled nearly 202,500 tons disposed annually, and approximately 79% of that waste stream was potentially recyclable or compostable. Non-recyclable materials made up almost 21% of the overall commercial waste stream. The most prevalent classes of recoverable materials were *organics (*36%) and *paper* (19%). Collectively, the top ten recoverable materials together represent approximately 58% of all commercial waste.

Detailed commercial composition findings are shown below for the overall commercial sector and for the three subsectors considered in this study – front loaders, compactors, and debris boxes. Three-quarters of commercial waste is collected via front loaders, with most of the remaining wastes collected in compactors. Less than three percent of commercially generated wastes are collected in permanent debris boxes. Estimated tons in the tables were extrapolated based on annual recycling tonnages provided by the City and on additional calculations by the consultant team to estimate the tons associated with each commercial subsector.

B. Waste Categories and Divertibility Analysis

The pie charts in the commercial section of this report are based on the recyclability or compostability of the material categories. The "top ten" material tables also focus on materials that are considered recoverable. The 57 material categories included in the commercial study also were categorized according to broad material classes – Paper, Plastic, Glass, Metal, Organics, Construction and Demolition Materials, Household Hazardous Waste, and Other. See Appendix D: Material Definitions for a detailed list and definitions of the 57 material categories that were used.

In the commercial study, recoverability categories include:

- **Recyclable:** This included materials for which technologies and markets exist in California to recover these materials from the waste stream, through recycling or composting.
- **Potentially Recyclable:** This included materials for which methods and/or technologies exist for recycling, reuse, or other beneficial uses, although programs to collect and process the materials are rare or nonexistent in the San Jose area. Examples of non-recyclable categories are those that are made of multiple materials (e.g. plastic and metal composite toys) or are otherwise problematic to handle and process.
- **Non-Recyclable:** This included materials that do not fit any of the definitions above and that are not easily diverted from disposal. This included materials for which technologies and markets have not been adequately developed to permit recovery of these materials from the waste stream.
- **Compostable:** This included organic materials that are appropriate for municipal composting programs.
- **HHW & Universal Waste:** This included Household Hazardous Waste and Universal Waste items that should not be disposed of in a landfill.

Table 26 shows the commercial material types grouped according to these recoverability categories.

Table 26. Recoverability of Materials in Commercial Waste

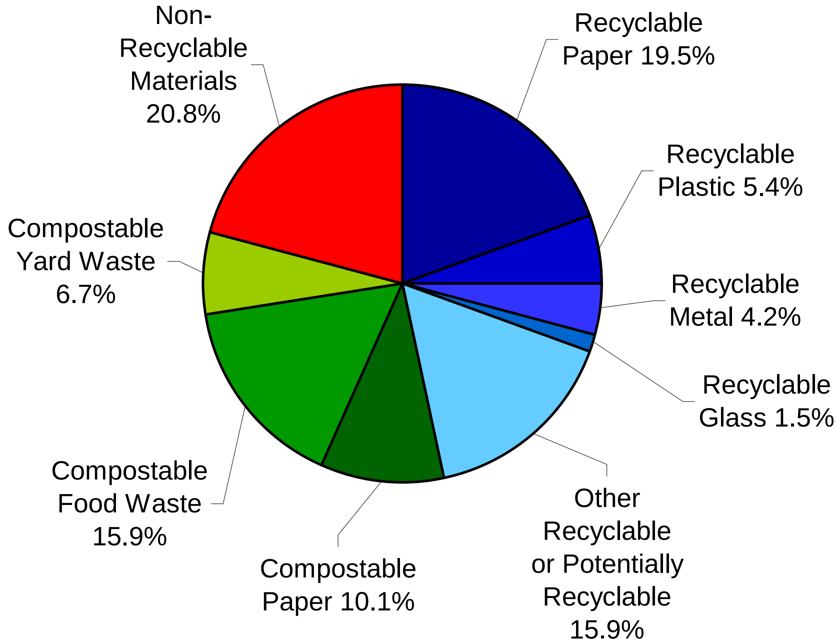
Recyclable	Non-Recyclable
#1 PET Bottles/Jars	Ash
#2 HDPE Bottles/Jars	Disposable Diapers
#3-#7 Bottles/Containers	Mixed Residue
Aluminum Cans	Other Film
Appliances	Other Glass
Books	Other Non-Ferrous
Clean Gypsum Board	Painted/Stained Lumber
Concrete/Brick/Asphalt	Remainder/Composite C&D
Cooking Grease	Remainder/Composite Organics
Ferrous/Bimetal Cans	Remainder/Composite Paper
Food Service Exp. Polystyrene	Remainder/Composite Plastic
Glass Bottles and Jars (all colors)	Treated Medical Waste
High Grade Paper	**Potentially Recyclable**
Mixed Recyclable Paper	Asphalt Composition Shingles
Non-Food Service Exp. Polystyrene	Carpet and Carpet Padding
OCC/Kraft	Ceramics
Other Ferrous	Flat Glass
Other Food Service Plastics	Furniture
Other Rock/Soil/Fines	Mattresses and Box Springs
Recoverable Film	Other Asphalt Roofing
Tires	Other Rigid Plastic
Untreated/Unpainted Lumber	Textiles/Leather/Rubber
Wax Coated OCC	Wood Shingles
Compostable	**HHW & Universal Waste**
Compostable Paper	HHW
Food Wastes	Car and Other Lead Acid Batteries
Leaves/Grass/Brush/Stumps	Compact Fluorescent Bulbs (CFLs)
	CRTs
	Electronic Devices
	Florescent Tubes
	Household & Other Small Batteries
	Other Remainder Composite HHW
	Pharmaceuticals/Household Medical

C. Commercial Waste Aggregate Results

Commercial waste results for overall waste, as well as waste for each subsector (vehicle or container type), are presented in three ways:

- A summary of waste composition by recoverability category is presented in a pie chart.
- The ten most prevalent recoverable material types, by weight, are shown in a table.
- A detailed table lists the full composition and quantity findings for all 86 material types.

Chart 10. Recoverability of Materials in Overall Commercial Disposed Waste



Approximately 35% of commercial waste is recyclable if it is properly source-separated, and another 33% is compostable. Only about 22% of the commercial waste stream is truly non-recyclable.

Table 27 below shows the top ten most prevalent recoverable materials in the overall commercial waste stream. Food waste was the largest portion at 16%, followed by compostable paper at just over 10%. Despite what is believed to be relatively active commercial recycling, it is significant that OCC/Kraft accounted for more than 9% of commercial waste. Taken together, the top ten most prevalent recoverable materials in the aggregate commercial waste stream represented almost 60% of commercial disposed waste.

Table 27. Overall Commercial Waste Top 10 Most Prevalent Recoverable Materials

Waste Material	Mean	Cum. %	Tons
Food Wastes	15.9%	15.9%	32,199
Compostable Paper	10.1%	26.0%	20,468
OCC/Kraft	9.1%	35.1%	18,419
Leaves/Grass/Brush/Stumps	6.7%	41.8%	13,556
Textiles/Leather/Rubber	3.6%	45.3%	7,206
Other Ferrous	3.1%	48.5%	6,323
Untreated/Unpainted Lumber	3.0%	51.5%	6,055
Other Rigid Plastic	2.7%	54.2%	5,520
High Grade Paper	2.3%	56.5%	4,657
Carpet and Carpet Padding	2.1%	58.6%	4,246
Subtotal	**58.6%**		**118,649**
All other materials combined	41.4%		83,884
Total	**100%**		**202,533**

Table 28 presents a detailed summary of commercial waste stream composition, including confidence intervals at a 95% confidence level and estimated annual tons for each material.

Table 28. Overall Commercial Waste Composition Results

Material	Est. %	+/-	Est. Tons	Material	Est. %	+/-	Est. Tons
Paper	30.6%		62,058	Construction and Demolition Materials	15.0%		30,478
OCC/Kraft	9.1%	0.02	18,419	Asphalt Composition Shingles	0.3%	0.01	632
Wax Coated OCC	1.4%	0.01	2,775	Other Asphalt Roofing	0.2%	0.00	351
Books	0.3%	0.00	602	Concrete/Brick/Asphalt	0.6%	0.01	1,265
Mixed Recyclable Paper	6.4%	0.01	12,971	Untreated/Unpainted Lumber	3.0%	0.01	6,055
High Grade Paper	2.3%	0.01	4,657	Painted/Stained Lumber	6.2%	0.03	12,469
Compostable Paper	10.1%	0.02	20,468	Wood Shingles	0.0%	-	-
Remainder/Composite Paper	1.1%	0.00	2,167	Clean Gypsum Board	0.0%	0.00	22
Plastics	15.1%		30,602	Ceramics	0.3%	0.00	567
#1 PET Bottles/Jars	0.6%	0.00	1,181	Carpet and Carpet Padding	2.1%	0.02	4,246
#2 HDPE Bottles/Jars	0.8%	0.00	1,591	Other Rock/Soil/Fines	0.8%	0.01	1,606
#3-#7 Bottles/Containers	0.2%	0.00	496	Remainder/Composite C&D	1.6%	0.02	3,265
Food Service Exp. Polystyrene	0.8%	0.00	1,610	Hazardous Materials	0.2%		441
Other Food Service Plastics	1.3%	0.00	2,541	HHW	0.1%	0.00	259
Non-Food Service Exp. Polystyrene	0.8%	0.00	1,653	Pharmaceuticals/Household Medical	0.1%	0.00	127
Recoverable Film	1.0%	0.00	1,940	Other Remainder Composite HHW	0.0%	0.00	55
Other Film	5.6%	0.01	11,322	Universal Waste	0.5%		1,088
Other Rigid Plastic	2.7%	0.01	5,520	Compact Fluorescent Bulbs (CFLs)	0.0%	0.00	7
Remainder/Composite Plastic	1.4%	0.01	2,747	Florescent Tubes	0.0%	0.00	15
Metal	4.8%		9,743	Car and Other Lead Acid Batteries	0.0%	0.00	1
Ferrous/Bimetal Cans	0.6%	0.00	1,159	Household & Other Small Batteries	0.0%	0.00	48
Other Ferrous	3.1%	0.02	6,323	CRTs	0.0%	0.00	9
Appliances	0.4%	0.00	724	Electronic Devices	0.5%	0.00	1,009
Aluminum Cans	0.2%	0.00	368	Other Materials	7.4%		15,011
Other Non-Ferrous	0.6%	0.00	1,169	Ash	0.0%	0.00	1
Glass	1.9%		3,949	Treated Medical Waste	0.9%	0.01	1,792
Glass Bottles and Jars (all colors)	1.5%	0.00	3,094	Mattresses and Box Springs	0.0%	0.00	46
Flat Glass	0.3%	0.00	583	Furniture	1.1%	0.01	2,325
Other Glass	0.1%	0.00	272	Tires	0.3%	0.01	563
Organic Materials	24.3%		49,162	Mixed Residue	1.5%	0.00	3,079
Food Wastes	15.9%	0.04	32,199	Textiles/Leather/Rubber	3.6%	0.01	7,206
Leaves/Grass/Brush/Stumps	6.7%	0.03	13,556				
Cooking Grease	0.0%	0.00	61				
Disposable Diapers	1.2%	0.01	2,333				
Remainder/Composite Organics	0.5%	0.00	1,013				
				Total	100%		202,533

D. Commercial Waste Results by Vehicle Type

1. Commercial Waste – Front Loader

This section presents composition findings for commercial waste that is collected in front-loading trucks.

Chart 11. Recoverability of Materials in Commercial Front Loaders

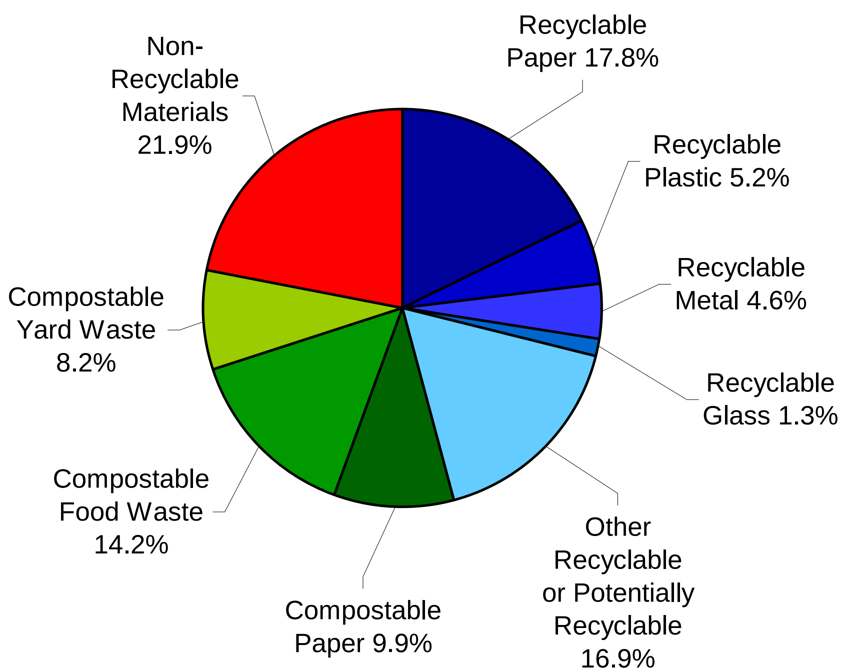


Table 29 shows the top ten most prevalent materials found in commercial waste collected in front loaders. The top ten recoverable materials together represent more than 63% of commercial front loader waste. Table 30 presents detailed composition estimates for all material types for commercial waste collected in front loaders.

Table 29. Top 10 Most Prevalent Recoverable or Potentially Recyclable Materials in Commercial Front Loader

Waste Material	Mean	Cum. %	Tons
Food Wastes	14.2%	14.2%	21,594
Compostable Paper	9.9%	24.1%	14,990
OCC/Kraft	8.6%	32.7%	13,073
Leaves/Grass/Brush/Stumps	8.2%	40.9%	12,456
Mixed Recyclable Paper	7.6%	48.5%	11,574
Other Ferrous	3.6%	52.1%	5,397
Textiles/Leather/Rubber	3.3%	55.3%	4,969
Untreated/Unpainted Lumber	3.2%	58.6%	4,877
Other Rigid Plastic	2.7%	61.3%	4,134
Carpet and Carpet Padding	2.5%	63.8%	3,773
Subtotal	**63.8%**		**96,838**
All other materials combined	36.2%		55,031
Total	**100%**		**151,869**

Table 30. Commercial Front Loader Composition Results

Material	Est. %	+/-	Est. Tons	Material	Est. %	+/-	Est. Tons
Paper	28.7%		43,513	Construction and Demolition Materials	18.1%		27,516
OCC/Kraft	8.6%	0.02	13,073	Asphalt Composition Shingles	0.4%	0.01	632
Wax Coated OCC	0.6%	0.01	967	Other Asphalt Roofing	0.2%	0.00	332
Books	0.3%	0.00	473	Concrete/Brick/Asphalt	0.7%	0.01	1,112
Mixed Recyclable Paper	6.3%	0.01	9,512	Untreated/Unpainted Lumber	3.2%	0.02	4,877
High Grade Paper	2.0%	0.01	3,015	Painted/Stained Lumber	7.6%	0.03	11,574
Compostable Paper	9.9%	0.02	14,990	Wood Shingles	0.0%	-	-
Remainder/Composite Paper	1.0%	0.00	1,482	Clean Gypsum Board	0.0%	0.00	22
Plastics	14.5%		22,017	Ceramics	0.3%	0.00	508
#1 PET Bottles/Jars	0.5%	0.00	821	Carpet and Carpet Padding	2.5%	0.02	3,773
#2 HDPE Bottles/Jars	0.8%	0.00	1,252	Other Rock/Soil/Fines	1.0%	0.01	1,445
#3-#7 Bottles/Containers	0.3%	0.00	407	Remainder/Composite C&D	2.1%	0.02	3,241
Food Service Exp. Polystyrene	0.7%	0.00	1,106	Hazardous Materials	0.2%		335
Other Food Service Plastics	1.2%	0.00	1,893	HHW	0.2%	0.00	237
Non-Food Service Exp. Polystyrene	0.8%	0.00	1,244	Pharmaceuticals/Household Medical	0.0%	0.00	75
Recoverable Film	0.7%	0.00	1,123	Other Remainder Composite HHW	0.0%	0.00	24
Other Film	5.3%	0.01	8,030	Universal Waste	0.6%		958
Other Rigid Plastic	2.7%	0.01	4,134	Compact Fluorescent Bulbs (CFLs)	0.0%	0.00	5
Remainder/Composite Plastic	1.3%	0.01	2,007	Florescent Tubes	0.0%	-	-
Metal	5.2%		7,943	Car and Other Lead Acid Batteries	0.0%	-	-
Ferrous/Bimetal Cans	0.6%	0.00	863	Household & Other Small Batteries	0.0%	0.00	40
Other Ferrous	3.6%	0.02	5,397	CRTs	0.0%	-	-
Appliances	0.3%	0.00	460	Electronic Devices	0.6%	0.00	914
Aluminum Cans	0.2%	0.00	282	Other Materials	6.5%		9,864
Other Non-Ferrous	0.6%	0.00	940	Ash	0.0%	-	-
Glass	1.9%		2,834	Treated Medical Waste	0.0%	-	-
Glass Bottles and Jars (all colors)	1.3%	0.00	2,048	Mattresses and Box Springs	0.0%	-	-
Flat Glass	0.4%	0.00	552	Furniture	1.1%	0.01	1,693
Other Glass	0.2%	0.00	233	Tires	0.4%	0.01	559
Organic Materials	24.3%		36,888	Mixed Residue	1.7%	0.01	2,643
Food Wastes	14.2%	0.04	21,594	Textiles/Leather/Rubber	3.3%	0.01	4,969
Leaves/Grass/Brush/Stumps	8.2%	0.03	12,456				
Cooking Grease	0.0%	0.00	24				
Disposable Diapers	1.4%	0.01	2,116				
Remainder/Composite Organics	0.5%	0.00	699				
				Total	100%		151,869

Some observations regarding waste in compactors included:

- At 8.6%, there were still meaningful amounts of OCC in front loader wastes. The same can be said for Mixed Recyclable Paper (6.3%) and High Grade Paper (2.0%).
- Front loader wastes had the most leaves/grass/brush at 8.2%. There would appear to be opportunity for incremental diversion of fibers from the front loader stream.
- Commingled containers (glass bottles, 1 & 2 plastic bottles, steel and aluminum cans) totaled only 3.5%. This suggests that some recycling of these items is occurring, but incremental improvement is possible.
- The highest fraction of disposable diapers was in front loader wastes, roughly double the percentage of both compactor and debris boxes.
- Front loader waste and debris box waste had the most lumber (both clean and treated) although front loader waste contained the largest fraction of miscellaneous (R/C) C&D debris.
- The highest fraction of electronic wastes was in front loaders (0.6% compared to half that fraction for compactors and debris boxes).
- Front loader waste contained the most "mixed residue" (materials that could not be elsewhere classified). This may reflect that front loader wastes are processed to the

greatest extent during collection (where they are both compacted and mixed) compared to the other forms of collection. This processing renders materials harder to identify.

2. Commercial Waste – Compactor

Compactor box waste contained significantly higher fractions of paper and plastics, and lower C&D debris relative to front loader and debris box waste. The top ten recoverable materials together represent more than 76% of commercial compactor waste.

Chart 12. Recoverability of Materials in Commercial Compactors

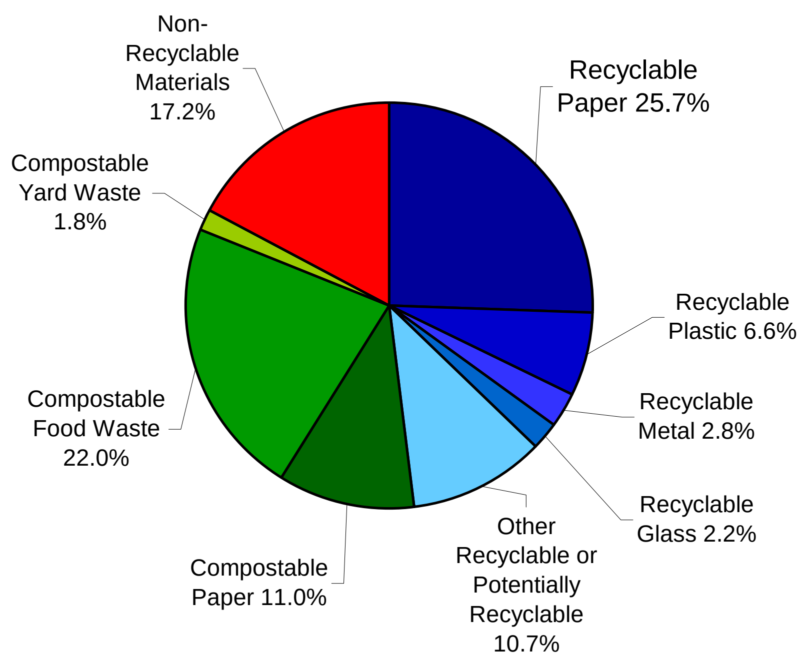


Table 31. Top 10 Most Prevalent Recoverable or Potentially Recyclable Materials in Commercial Compactors

Waste Material	Mean	Cum. %	Tons
Food Wastes	22.0%	22.0%	9,875
OCC/Kraft	11.1%	33.1%	4,981
Compostable Paper	11.0%	44.1%	4,952
Mixed Recyclable Paper	7.1%	51.2%	3,164
Other Film	6.9%	58.1%	3,090
Textiles/Leather/Rubber	4.6%	62.7%	2,060
Wax Coated OCC	4.0%	66.7%	1,792
High Grade Paper	4.0%	70.7%	1,791
Other Rigid Plastic	3.3%	73.9%	1,477
Glass Bottles and Jars (all colors)	2.8%	76.7%	1,256
Subtotal	**76.7%**		**34,437**
All other materials combined	23.3%		10,436
Total	**100%**		**44,873**

Table 32. Commercial Compactor Composition Results

Material	Est. %	+/-	Est. Tons	Material	Est. %	+/-	Est. Tons
Paper	38.2%		17,140	Construction and Demolition Materials	3.1%		1,382
OCC/Kraft	11.1%	0.02	4,981	Asphalt Composition Shingles	0.0%	-	-
Wax Coated OCC	4.0%	0.02	1,791	Other Asphalt Roofing	0.0%	-	-
Books	0.3%	0.00	116	Concrete/Brick/Asphalt	0.0%	0.00	4
Mixed Recyclable Paper	7.1%	0.02	3,164	Untreated/Unpainted Lumber	1.7%	0.01	769
High Grade Paper	3.3%	0.02	1,477	Painted/Stained Lumber	1.0%	0.01	431
Compostable Paper	11.0%	0.02	4,952	Wood Shingles	0.0%	-	-
Remainder/Composite Paper	1.5%	0.01	660	Clean Gypsum Board	0.0%	-	-
Plastics	17.7%		7,939	Ceramics	0.0%	0.00	16
#1 PET Bottles/Jars	0.8%	0.00	340	Carpet and Carpet Padding	0.0%	0.00	20
#2 HDPE Bottles/Jars	0.7%	0.00	321	Other Rock/Soil/Fines	0.3%	0.00	143
#3-#7 Bottles/Containers	0.2%	0.00	72	Remainder/Composite C&D	0.0%	-	-
Food Service Exp. Polystyrene	1.1%	0.00	478	Hazardous Materials	0.2%		87
Other Food Service Plastics	1.4%	0.00	611	HHW	0.0%	0.00	18
Non-Food Service Exp. Polystyrene	0.9%	0.01	391	Pharmaceuticals/Household Medical	0.1%	0.00	38
Recoverable Film	1.7%	0.01	770	Other Remainder Composite HHW	0.1%	0.00	31
Other Film	6.9%	0.01	3,090	Universal Waste	0.2%		102
Other Rigid Plastic	2.8%	0.01	1,256	Compact Fluorescent Bulbs (CFLs)	0.0%	0.00	2
Remainder/Composite Plastic	1.4%	0.01	610	Florescent Tubes	0.0%	0.00	14
Metal	3.2%		1,426	Car and Other Lead Acid Batteries	0.0%	-	-
Ferrous/Bimetal Cans	0.6%	0.00	280	Household & Other Small Batteries	0.0%	0.00	7
Other Ferrous	1.4%	0.01	628	CRTs	0.0%	-	-
Appliances	0.6%	0.01	253	Electronic Devices	0.2%	0.00	78
Aluminum Cans	0.2%	0.00	79	Other Materials	10.3%		4,610
Other Non-Ferrous	0.4%	0.00	187	Ash	0.0%	-	-
Glass	2.2%		1,007	Treated Medical Waste	4.0%	0.05	1,792
Glass Bottles and Jars (all colors)	2.2%	0.01	972	Mattresses and Box Springs	0.0%	-	-
Flat Glass	0.0%	0.00	11	Furniture	0.8%	0.01	378
Other Glass	0.1%	0.00	23	Tires	0.0%	-	-
Organic Materials	24.9%		11,181	Mixed Residue	0.8%	0.00	380
Food Wastes	22.0%	0.04	9,874	Textiles/Leather/Rubber	4.6%	0.02	2,060
Leaves/Grass/Brush/Stumps	1.8%	0.01	827				
Cooking Grease	0.1%	0.00	37				
Disposable Diapers	0.4%	0.00	178				
Remainder/Composite Organics	0.6%	0.00	263				
				Total	100%		44,873

Some observations regarding waste in compactors included:

- At 11.1%, OCC/Kraft was notably higher in compactor boxes than in the other commercial subsectors. This is perhaps counterintuitive, as it might be reasoned that establishments that are large enough to warrant compactor box service should probably be able to recover enough OCC to also warrant separate OCC collection. It could be that these establishments create greater contamination of OCC (e.g., supermarkets with food-contaminated OCC).
- There was more food waste in compactors (22%) compared to front loaders and debris boxes. This might have been related to the higher OCC disposal rate.
- There was more wax coated OCC in compactor boxes (4.0%) than in waste from the other commercial subsectors.
- There was virtually no green waste in compactor boxes (1.8%) in comparison to front loaders and debris boxes.
- There was nearly twice as much recoverable film plastic in compactor boxes (1.7%) compared to front loaders and debris boxes.

- There was less than half as much Other Ferrous in compactor boxes compared to front loaders and debris boxes (1.4%).
- There was very little C&D debris with the exception of untreated and treated wood in compactor boxes.
- Our sampling plan was based on random selection of compactor box loads based on the universe of loads collected by the two haulers participating in this study. One of the haulers had a 30-yard compactor contracted to a local hospital, which was serviced frequently. This compactor box was comprised entirely of treated medical waste, a separate category. Discounting these samples from analysis, no other instance of treated medical waste was noted.

3. Commercial Waste – Debris Box

Table 34 shows the results of the debris box material categories by percentage. During the planning stages of the sampling plan, it was presumed that as much as 50% of the debris boxes could have large bulky items that would make the loads not suitable for physical sampling. Single bulky items such as carpet, furniture, and C&D material could weigh as much as 200 pounds, so the sampling plan called for some incoming debris boxes that had bulky or homogenous wastes that would be observed visually as opposed to a 200 pound physical sort. Of the 41 loads sampled, 27 incoming loads were sampled for physical sorting and 14 incoming loads were visually observed. To integrate the two sampling methods for analysis, a weighted average was calculated and applied to each sampling method.

As shown, the C&D category was the largest portion of the debris box waste stream at just over 27%. Paper was next at just over 24% and organics were next at almost 19%. Plastics were next at just over 11% then metals at almost 7%. Other wastes came in at just over 9% then glass at just about 2% and HHW and universal wastes were both under 1% each. The top ten recoverable materials together represent more than 65% of commercial debris box waste.

Chart 13 shows the prevalence of recyclable and compostable materials in commercial debris box waste. Just over 33% of this waste stream is recyclable, while almost 22% is potentially recyclable. Almost 28% is compostable. The potentially recyclable materials are materials that may have a current or developable market. These materials would require handling or some disassembly prior to entering the recycling market.

Chart 13. Recoverability of Materials in Commercial Debris Boxes

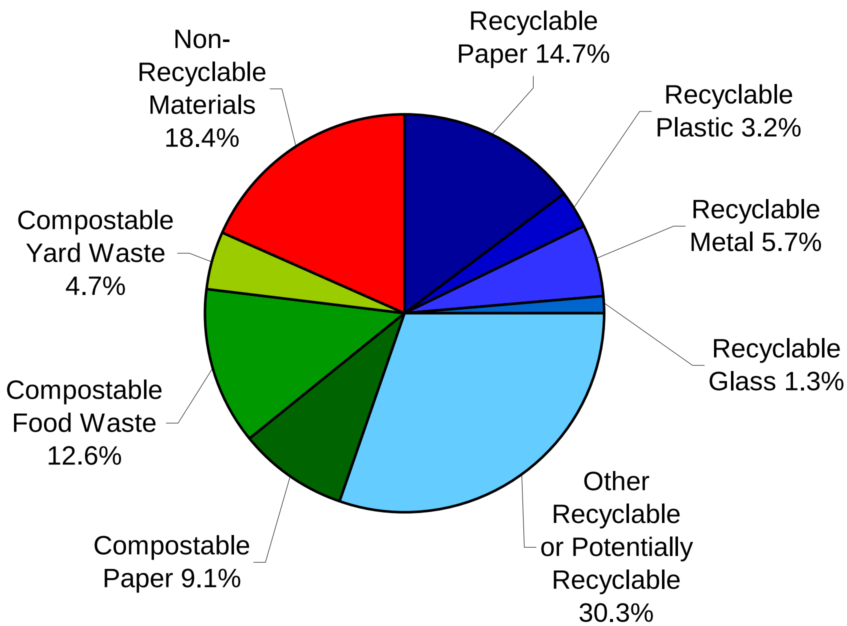


Table 33 shows the top ten most prevalent materials found in the debris box waste stream. This figure shows that food wastes and compostable paper were the most prevalent of the materials in the waste stream at almost 13 and 9%, respectively. Then treated lumber (painted or stained) was 8%. Carpet and carpet padding was almost 8%. OCC/Kraft paper was just over 6%. Other ferrous and mixed recyclable paper was both a little over 5% each. Green wastes (leaves, grass, brush, and stumps) and furniture were last at almost 5% and just over 4%, respectively. All total the top ten most prevalent recoverable materials comprised almost 66% of the debris box waste stream.

Table 33. Commercial Waste Debris Box Top 10 Most Prevalent Recoverable Materials

Waste Material	Mean	Cum. %	Tons
Food Wastes	12.6%	12.6%	729
Compostable Paper	9.1%	21.7%	525
Carpet and Carpet Padding	7.8%	29.5%	453
Untreated/Unpainted Lumber	7.1%	36.6%	412
OCC/Kraft	6.3%	42.9%	365
Other Ferrous	5.1%	48.0%	296
Mixed Recyclable Paper	5.1%	53.1%	294
Leaves/Grass/Brush/Stumps	4.7%	57.8%	273
Furniture	4.4%	62.2%	254
Other Film	3.5%	65.7%	202
Subtotal	**65.7%**		**3,803**
All other materials combined	34.3%		1,988
Total	**100%**		**5,791**

Table 34 shows the results of the debris box waste stream for all materials.

Table 34. Commercial Waste Debris Box Composition Results

Material	Est. %	+/-	Est. Tons	Material	Est. %	+/-	Est. Tons
Paper	24.2%		1,403	Construction and Demolition Materials	27.3%		1,582
OCC/Kraft	6.3%	0.03	365	Asphalt Composition Shingles	0.0%	0.00	0
Wax Coated OCC	0.3%	0.01	17	Other Asphalt Roofing	0.3%	0.00	19
Books	0.2%	0.00	13	Concrete/Brick/Asphalt	2.6%	0.03	149
Mixed Recyclable Paper	5.1%	0.02	294	Untreated/Unpainted Lumber	7.1%	0.05	412
High Grade Paper	2.8%	0.02	164	Painted/Stained Lumber	8.0%	0.04	463
Compostable Paper	9.1%	0.03	525	Wood Shingles	0.0%	-	-
Remainder/Composite Paper	0.4%	0.00	25	Clean Gypsum Board	0.0%	-	-
Plastics	11.1%		645	Ceramics	0.7%	0.01	42
#1 PET Bottles/Jars	0.4%	0.00	20	Carpet and Carpet Padding	7.8%	0.07	453
#2 HDPE Bottles/Jars	0.3%	0.00	17	Other Rock/Soil/Fines	0.3%	0.00	18
#3-#7 Bottles/Containers	0.3%	0.00	17	Remainder/Composite C&D	0.4%	0.00	24
Food Service Exp. Polystyrene	0.4%	0.00	26	Hazardous Materials	0.3%		20
Other Food Service Plastics	0.7%	0.00	38	HHW	0.1%	0.00	5
Non-Food Service Exp. Polystyrene	0.3%	0.00	19	Pharmaceuticals/Household Medical	0.3%	0.00	15
Recoverable Film	0.8%	0.01	47	Other Remainder Composite HHW	0.0%	0.00	0
Other Film	3.5%	0.01	202	Universal Waste	0.5%		28
Other Rigid Plastic	2.2%	0.01	129	Compact Fluorescent Bulbs (CFLs)	0.0%	0.00	0
Remainder/Composite Plastic	2.2%	0.02	130	Florescent Tubes	0.0%	0.00	0
Metal	6.4%		373	Car and Other Lead Acid Batteries	0.0%	0.00	1
Ferrous/Bimetal Cans	0.3%	0.00	17	Household & Other Small Batteries	0.0%	0.00	1
Other Ferrous	5.1%	0.03	296	CRTs	0.2%	0.00	9
Appliances	0.2%	0.00	11	Electronic Devices	0.3%	0.00	18
Aluminum Cans	0.1%	0.00	7	Other Materials	9.3%		540
Other Non-Ferrous	0.7%	0.01	42	Ash	0.0%	0.00	1
Glass	1.9%		108	Treated Medical Waste	0.0%	-	-
Glass Bottles and Jars (all colors)	1.3%	0.01	73	Mattresses and Box Springs	0.8%	0.01	46
Flat Glass	0.3%	0.00	20	Furniture	4.4%	0.03	254
Other Glass	0.3%	0.00	16	Tires	0.1%	0.00	4
Organic Materials	18.9%		1,092	Mixed Residue	1.0%	0.00	55
Food Wastes	12.6%	0.05	729	Textiles/Leather/Rubber	3.1%	0.01	181
Leaves/Grass/Brush/Stumps	4.7%	0.03	273				
Cooking Grease	0.0%	-	-				
Disposable Diapers	0.7%	0.01	39				
Remainder/Composite Organics	0.9%	0.01	51				
				Total	100%		5,791

Some observations regarding waste in debris boxes relative to the other commercial subsectors included:

- Debris boxes contained the least OCC (6.3%).
- Debris boxes contained the most Other Ferrous (5.1%).
- Debris boxes contained approximately the same mass of Food Waste (12.6%).
- Debris boxes contained half as much Leaves/Grass/Brush/Stumps (4.7%) as front loader waste
- Debris boxes contained the most untreated wood waste (7.1%), treated/painted wood waste (8.0%), and carpet/backing (7.8%).
- Debris box loads contained substantially more furniture than all other categories (4.4%).

Appendix A: Analytical Procedures

To develop waste characterization and quantity profiles for this study, three main steps were taken. These steps are as follows:

1. Convert volumetric estimates of materials to weight for the self-haul samples.
2. Calculate the estimated composition of all samples in a given vehicle type, based on the sample weight.
3. Combine the results for individual strata, using a weighted average procedure, to produce findings for each vehicle type. Apply tonnage figures for disposed waste to the composition estimates, to derive tonnage estimates for each material disposed.

A. Converting Volumes to Weights

The composition calculations rely on the availability of individual material weights for each sample. As described in Appendix B. Sampling Methodology, the data that were collected to characterize each self-haul sample in this study included volume estimates. Cascadia converted volume estimates to weights using accepted waste density conversion factors. These factors are listed in Table 37 at the end of this appendix, and data sources accompany the table.

Using the volume-to-weight conversion factors and the volume estimates obtained during the characterization of each sample, individual material weights were calculated using the following formula:

$$c = m \times s \times v \times d$$

where:

c = the total weight of the specific material in the sample

m = percentage estimate of the material, as a portion of broad material class (e.g., the extent to which newspaper constitutes all of the paper in the sample)

s = percentage estimate of the material class, as a portion of all of the material in the sample (e.g., the extent to which paper constitutes all of the material in the sample)

v = total volume of the sample (in cubic yards)

d = density conversion of the material (in pounds/cubic yard)

B. Statistical Measures

Once each sample was converted from volume to weight as described above, the following statistical measures were calculated to determine the overall composition of each waste stream.

- **Sample Mean:** The sample mean, or average, composition is considered the "most likely" fraction for each material category in the waste stream. The sample mean is determined by (i) summing the weight of each material in each sample; (ii) summing the total weight of all samples, and (iii) dividing the first value by the second value to determine the percent-by-weight composition. Note that the *sample* mean, while a good estimate, is unlikely to be identical to the *population* mean value. The meaningfulness of the sample mean is enhanced by the following statistical measures.

- **Standard Deviation**: The standard deviation measures how widely values within the data set are dispersed from the sample mean. A higher standard deviation denotes higher variation in the underlying samples for each material, while a lower standard deviation reflects lower variation among the individual samples. The standard deviation is stated in the same unit as the sample mean, which in this case is percent by weight.
- **Confidence Intervals**: When a sample of data is obtained, it is analyzed in an attempt to determine certain values that describe the entire population of data under analysis. For example, in a poll of likely voters, the intent of the poll is to determine the percentage of *all* voters who support a given candidate, not simply the percentage of voters *in the poll* who support that candidate. The percentage of voters who support a given candidate in the poll can easily vary from sample to sample; but the percentage of *all* voters who support that candidate is a fixed value. In our sample of incoming loads of commercial waste, we are not primarily interested in the percentage composition of the *sampled* loads, but rather in trying to determine what the composition of the sampled loads tells us about the composition of *all* commercial waste generated in San Jose. A confidence interval is a statistical concept that attempts to indicate the likely range within which the true value lies. The confidence intervals reflect the upper and lower range within which the population mean can be expected to fall. Confidence intervals require the following "inputs":
    - The "level of confidence", or how sure one wants to be that the interval being constructed will actually encompass the population mean;
    - The sample mean, around which the confidence interval will be constructed;
    - The sample standard deviation, which is used as a measure of the variability of the population from which the sample was obtained; and
    - The number of sampling units that comprised the sample (a.k.a. sample size).

Throughout the commercial waste results section, confidence intervals have been calculated at a 95% level of confidence, meaning that we can be 95% sure that the population mean falls within the upper and lower confidence intervals shown. (The converse is also true: that there is a 5% chance that the population mean falls outside of the sample mean.) In general, as the number of samples increases, the width of the confidence intervals decreases, although the more variable the underlying waste stream composition, the less noticeable the improvement for adding incremental samples.

C. Composition Calculations

The composition estimates represent the **ratio of the material's weight to the total sampled waste** for each noted vehicle type. They are derived by summing each material's weight across all of the selected samples and dividing by the sum of the total weight of sampled waste, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i}$$

where:

c = weight of particular material

w = sum of all sampled material weights

for i 1 to n

where n = number of selected samples

for j 1 to m

where m = number of materials

The confidence interval for this estimate is derived in two steps. First, the variance around the estimate is calculated, accounting for the fact that the ratio includes two random variables (the material and total sample weights). The **variance of the ratio estimator** equation follows:

$$\hat{V}_{r_j} = \left(\frac{1}{n}\right) \cdot \left(\frac{1}{\overline{w}^2}\right) \cdot \left(\frac{\sum_i (c_{ij} - r_j w_i)^2}{n-1}\right)$$

where:

$$\overline{w} = \frac{\sum_i w_i}{n}$$

Second, **precision levels** at the 95% confidence interval are calculated for a material's mean as follows:

$$r_j \pm \left(t \cdot \sqrt{\hat{V}_{r_j}}\right)$$

where:

t = the value of the t-statistic (1.960) corresponding to a 95% confidence level

For more detail, please refer to Chapter 6 "Ratio, Regression and Difference Estimation" of *Elementary Survey Sampling* by R.L. Scheaffer, W. Mendenhall and L. Ott (PWS Publishers, 1986).

The **weighted average for an overall composition estimate** is performed as follows:

$$O_j = (p_1 * r_{j1}) + (p_2 * r_{j2}) + (p_3 * r_{j3}) + ...$$

where:

p = the proportion of tonnage contributed by the noted sample group

r = ratio of material weight to total waste weight in the noted sample group

for j = 1 to m

where m = number of materials

The **variance of the weighted average** is calculated:

$$VarO_j = (p_1^2 * \hat{V}_{r_{j1}}) + (p_2^2 * \hat{V}_{r_{j2}}) + (p_3^2 * \hat{V}_{r_{j3}}) + ...$$

The composition estimates for the overall waste stream were applied to the sum of the sector tonnages to estimate the amount of waste disposed for each material type.

Commercial: The weighted averages for aggregating the three commercial substreams are shown below.

Table 35. Total Quantity and Weighting Factors for Commercial Wastes

	Front loader Collection	Compactor Roll-off	Permanent Debris Box	Total Commercial
Tons	151,869	44,873	5,791	202,533
Weighting	75.0%	22.2%	2.9%	100%

Note, however, that is was also necessary to aggregate the visually surveyed and physically sorted samples from the debris box substream. This is an important step because physically sorted samples were based on 200 to 250 pound grabs, while visual samples were based on surveys of entire incoming truckloads. It was therefore not possible to treat the physically sorted and visually surveyed data points as equal weight. Rather, each set of debris box samples was analyzed separately according to the methods above. Aggregation of the physically sorted and visually surveyed subsets is described below.

It was not known prior to the field study what fraction of incoming loads would require physical sorting or visual surveying, nor the fraction of debris box total weight that required physical versus visual sorting. Therefore, the fraction of incoming debris box loads requiring each type of sampling method was used as the basis to aggregate debris box composition. Of the 41 debris box samples obtained at random, 27 required physical sampling and the remaining 14 required visual surveying. Table 36 shows the weighting factors used to aggregate debris box loads.

Table 36. Weighting Factors for Physically Sorted and Visually Surveyed Debris Box Wastes

	Physically Sorted	Visually Surveyed	Total Debris Box
Samples	*27*	*14*	*41*
Weighting	*65.9%*	*34.1%*	*100%*

Generically, the weighting methodology for combining both commercial substreams as well as the debris box physical and visual streams is shown in the equation below. In this equation, O_j represents the mean percent estimate for material j in the overall, or weighted, substream profile. The mean percent for the material in each substream is numbered 1, 2, 3, etc. The relative weighting factors for each substream, expressed as percentages of total tonnage disposed for a larger "overall" waste stream, are represented by the variables p_1, p_2, p_3, etc. The mean estimate of the percent of the disposed waste stream corresponding to the material j for each subsector is represented by the variables r_{j1}, r_{j2}, r_{j3}, etc.

$$O_j = (p_1 * r_{j1}) + (p_2 * r_{j2}) + (p_3 * r_{j3}) + ...$$

where:

p = the proportion of disposed waste contributed by a given subsector in relation to the quantity of waste associated with the larger overall, or weighted, sector profile

r = ratio of material weight to total waste weight for the subsector or the metropolitan area, as applicable

for j = 1 to m, where m = number of materials

The variance of the weighted average is calculated:

$$VarO_j = (p_1{}^2 * \hat{V}_{r_{j1}}) + (p_2{}^2 * \hat{V}_{r_{j2}}) + (p_3{}^2 * \hat{V}_{r_{j3}}) + ...$$

where:

$\hat{V}_{r_j}$ = variance associated with the composition estimate for a given material in a given substream

Table 37. Volume-to-Weight Conversion Factors

Subclass ID	Subclass	Conversion Factor	Conversion Source
1	Uncoated Corrugated Cardboard	53.00	CIWMB2004
2	Paper Bags	108.00	San Diego County- Kraft Paper
3	Other Recyclable Paper	295.00	U.S. EPA (Average of newspaper, office paper, and magazines)
4	Cellulose Insulation	17.00	U.S. EPA
5	R/C Paper	363.50	U.S. EPA
6	Glass Bottles and Containers	600.00	U.S. EPA
7	Flat Glass	1,400.00	U.S. EPA
8	R/C Glass	1,400.00	U.S. EPA
9	Tin/Steel Cans	150.00	U.S. EPA
10	Major Appliances	145.00	CIWMB2004
11	Used Oil Filters	834.40	Tellus
12	HVAC Ducting	47.00	CIWMB2004
13	Other Ferrous	225.00	CIWMB2004
14	Aluminum Cans	65.00	U.S. EPA
15	Other Non-Ferrous	225.00	CIWMB2004
16	R/C Metal	142.83	Average of all "metals" without Used Oil Filters
17	Brown Goods and Other Small Consumer Electronics	343.17	CIWMB Staff
18	Computer-related Electronics	354.08	CIWMB Staff
19	TV's & Other CRTs	405.00	CIWMB Staff
20	Plastic Bottles and Tubs	29.50	Average of PETE Containers and HDPE Containers
21	Other Rigid Packaging	21.76	Tellus
22	Expanded #6/Polystyrene Packaging/Insulation	32.00	CIWMB2004
23	Trash Bags	35.00	CIWMB2004
24	Grocery/ Merch. Bags	35.00	CIWMB2004
25	Non-Bag Packaging Film	35.00	CIWMB2004
26	Plastic Sheeting and Agricultural Film	35.00	CIWMB2004 - non bag packaging film
27	Other Film	22.55	Tellus
28	Durable Plastic Items	50.00	U.S. EPA
29	Plastic Piping	281.50	Tellus/Cascadia
30	R/C Plastic	50.00	U.S. EPA
31	Food	486.00	FEECO, Tellus
32	Leaves & Grass	312.50	U.S. EPA
33	Prunings & Trimmings	127.00	CIWMB2004
34	Branches & Stumps	127.00	CIWMB2004
35	R/C Organic	263.13	Average of all "Compostables"
36	Concrete	860.00	CIWMB2004
37	Asphalt Paving	772.80	Tellus scaled down by factor from Florida C&D study
38	Composition Roofing	731.00	CIWMB2004
39	Other Asphalt Roofing	731.00	CIWMB2004
40	Other Aggregates	860.00	CIWMB2004
41	Clean Dimensional Lumber	169.00	CIWMB2004
42	Clean Engineered Wood	268.00	CIWMB2004
43	Pallets and Crates	169.00	CIWMB2004
44	Other Recyclable Wood	169.00	CIWMB2004
45	Painted/Stained Wood	169.00	CIWMB2004
46	Creosote-treated Wood	169.00	CIWMB2004
47	Other Treated Wood	169.00	CIWMB2004
48	Clean Gypsum Board	467.00	CIWMB2004
49	Painted/Demolition Gypsum	467.00	CIWMB2004
50	Rock and Gravel	999.00	CIWMB2004
51	Dirt and Sand	929.00	CIWMB2004
52	Fiberglass insulation	17.00	Tellus
53	R/C C&D	416.53	CIWMB2004
54	Paint	1,836.00	Tellus
55	Vehicle & Equip. Fluids	1,653.00	Tellus
56	Used Oil	1,524.94	Tellus
57	Batteries	2,400.00	CIWMB Staff
58	R/C HHW	1,671.31	Average of HHW liquids
59	Textiles	225.00	Tellus
60	Carpet	147.00	CIWMB2004
61	Carpet Padding	62.00	CIWMB2004
62	Ash	1,012.50	FEECO
63	Bulky Items	80.00	Tellus
64	Tires	200.00	CIWMB Staff
65	R/C Other	142.80	Average of all "other materials," except ash
66	Mixed Residue	999.00	FEECO
67	MSW	225.00	U.S. EPA

Data Source Abbreviations

Following are the descriptions of the sources from which data were gathered for the conversion factors listed in Table C-2. The materials showing no conversion factors were not encountered during the study.

Cascadia Staff refers to direct measurements of representative samples taken by Cascadia staff members for this and other studies.

CIWMB refers to *Conducting a Diversion Study - A Guide for California Jurisdictions,* California Integrated Waste Management Board, 2001.

CIWMB 2004 refers to *Task 3: Detailed Characterization of Construction and Demolition (C&D) Waste Study*, California Integrated Waste Management Board, 2004.

FEECO refers to FEECO International, *Complete Systems and Equipment Handbook*, 9th printing.

San Diego County refers to *San Diego: Waste Composition Study*, City of San Diego Environmental Services Department, 1999-2000.

Tellus refers to the Tellus Institute, Boston, Massachusetts**.**

US EPA refers to the *Business Waste Prevention Quantification Methodologies - Business Users Guide*: Washington, D.C. and Los Angeles: U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste, and University of California at Los Angeles Extension, Recycling and Municipal Solid Waste Management Program: Grant Number CX 824548-01-0, 1996.

D. Weighted Averages

The overall residential waste composition estimates and the overall commercial waste composition estimates were calculated by performing a weighted average across the relevant subsectors (i.e., districts for residential waste and vehicle types for commercial waste). The estimates for each sector were calculated using a weighted procedure which was based on the tonnage estimates provided by the City of San Jose for each waste sector and each district.

The weighting percentages that were used to perform the overall characterization calculations are listed in Table 38. Residential Waste Weighting Percentages and Table 39. Residential Recycling Weighting Percentages below. Tonnage estimates were provided by the City of San Jose for each of the waste sectors.

Table 38. Residential Waste Weighting Percentages

District A	49.27%
District B	19.42%
District C	31.31%
Total	**100.00%**

Table 39. Residential Recycling Weighting Percentages

District A	41.35%
District B	26.06%
District C	32.59%
Total	**100.00%**

Table 40. MRF Weighting Percentages

Districts A & C	83.35%
District B	16.65%
Total	**100.00%**

Table 41. Commercial Weighting Percentages

Frontload Collection	74.98%
Compactor Rolloff	22.16%
Debris Box	2.86%
Total	**100.00%**

Appendix B: Detailed Study Methodology

A. Summary of Sampling Activity

Table 42. Number of Samples Characterized, Residential Waste and Recycling[4]

	District A	District B	District C
Minimum number of households targeted	370	370	370
Households visited by special collection drivers	**497**	**499**	**499**
Households from which garbage samples were collected	419	429	431
Households that had no garbage set out	48	47	34
Households from which recycling samples were collected	336	376	392
Households that had no recycling set out	125	99	73

Table 43. Number of Samples Characterized, MRF Residual Waste

	District A & C CWS	District B GT
Sample goals	8	4
Samples characterized	**8**	**4**

Table 44. Number of Samples Characterized, Commercial Waste

	Front Loaders	Compactors	Debris Boxes	Totals
Initial targeted numbers of samples	40	40	40	120
Hand-sorted samples	41	41	27	
Visually characterized samples	1	2	14	
Total samples characterized	**42**	**43**	**41**	**126**

B. Residential Field Data Collection Procedures

To maximize the overall number of samples obtained and to provide results consistent with the previous waste characterization studies, a different number of samples were allocated to each waste sector. The data collection process for each sector also employed different characterization methods. Table 45 and Table 46 show the planned sample allocation for residential waste and recycling.

1. Allocation of Samples

A sample of residential waste was defined as the garbage set-out contained in a standard, city-approved container, from one single-family household. Similarly, a sample of residential

[4] The number of "households visited by drivers" varies from the number of "samples collected." Riders noted some households were visited where the residents did not set out their garbage, recycling, or both carts. The riders further noted that some households visited were for sale or under construction.

recycled material was defined as the recycling set-out contained in a standard, city-approved container from one single-family household.

Two trucks from California Waste Systems (CWS) visited selected households in District A during the first week of the study, March 17-21. On each day of that week, each team visited 37 to 50 households and collected all set-out material in the garbage and recycling containers, keeping garbage separate from recycling in split bodied trucks.

Similarly, two trucks from CWS visited selected households in District C during the second week of the study, March 24-28. On each day of that week, each team visited 37 to 50 households and collected all set-out material in the garbage and recycling containers, keeping garbage separate from recycling in split bodied trucks.

A single truck from GreenTeam visited 37 to 50 households in District B on each day of the two-week sampling period. The GreenTeam truck collected the garbage and recycling set-outs, separately, from each selected household.

The allocation of samples for residential waste and recycling is shown in Table 45 and Table 46 below.

Table 45. Allocation of Single-Family Residential Waste Samples

	Mon. March 17	Tue. March 18	Wed. March 19	Thur. March 20	Fri. March 21	Mon. March 24	Tue. March 25	Wed. March 26	Thur. March 27	Fri. March 28	Total Samples
Service District A											
Co-collection truck #1	45-50	45-50	45-50	45-50	45-50						**481-500**
Co-collection truck #2	45-50	45-50	45-50	45-50	45-50						
Service District B											
Co-collection truck	45-50	45-50	45-50	45-50	45-50	45-50	45-50	45-50	45-50	45-50	**481-500**
Service District C											
Co-collection truck #1						45-50	45-50	45-50	45-50	45-50	**481-500**
Co-collection truck #2						45-50	45-50	45-50	45-50	45-50	
Total waste samples	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**1,443-1,500**

Table 46. Allocation of Single-Family Residential Recycling Samples

	Mon. March 17	Tue. March 18	Wed. March 19	Thur. March 20	Fri. March 21	Mon. March 24	Tue. March 25	Wed. March 26	Thur. March 27	Fri. March 28	Total Samples
Service District A											
Co-collection truck #1	45-50	45-50	45-50	45-50	45-50						**481-500**
Co-collection truck #2	45-50	45-50	45-50	45-50	45-50						
Service District B											
Co-collection truck	45-50	45-50	45-50	45-50	45-50	45-50	45-50	45-50	45-50	45-50	**481-500**
Service District C											
Co-collection truck #1						45-50	45-50	45-50	45-50	45-50	**481-500**
Co-collection truck #2						45-50	45-50	45-50	45-50	45-50	
Total recycling samples	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**135-150**	**1,443-1,500**

The City provided the consultant team with a list of households that were visited by trucks in each district on each day of the study. The list for each truck on each day included approximately 50 households. The hauling companies used the household lists from the city to develop their own routed collection schedules. The regular route drivers were notified of the study and given a list of households not to collect on specified days. The special collection trucks visited each household on the routed collection list and collected both the waste and recycling set-outs from that household.

Waste collected from selected households by each special sampling truck was mixed together within the truck during the collection process. Similarly, recycled material collected from selected households by each sampling truck was mixed together within the truck during sampling. This resulted in three "lumped samples" of single-family residential waste and three "lumped samples" of single-family residential recycling being collected and delivered to the sorting team on each day of the study. Each lumped sample of residential waste was expected to weigh approximately 1,500 pounds, and each lumped sample of residential recycling was expected to weigh approximately 800 pounds.

2. Collection of Samples

CWS collected all targeted garbage and recycling set-outs in districts A and C. Two split bodied trucks were responsible for collecting all garbage and recycling from selected addresses from their assigned list of households. GreenTeam collected all targeted garbage and recycling set-outs in district B. GreenTeam also used split body collection trucks, one truck per day.

GreenTeam developed one list of approximately 50 households for each sampling day, and CWS was provided one list of approximately 50 households for each sampling day from Garden City Sanitation. CWS and GreenTeam mapped efficient routes for each truck to visit the households on each list, using their GPS and mapping software.

Each collection truck had a member of the consultant team (a "rider") accompany them during the collection vehicle to verify addresses and samples collected and to record any other field notes on the *sample collection form*. After waste and recycling from all selected addresses had been collected on a given day, the resulting lumped samples were transported to the GreenWaste Recovery, Inc. facility (625 Charles Street) and were tipped onto the sorting floor, located within one "bay" at the GreenWaste Recovery facility. Each lumped sample was tipped separately and labeled with a *sample placard*, which identified the date, service district, and substream (garbage or recycling) of each lumped sample. Each lumped sample was kept separate from other lumped samples to prevent mixing of any material among lumped samples.

It was the responsibility of GCS, CWS, and GreenTeam to notify their regular collection drivers on each day of the study and to provide a list of households from which material was not to be collected. The Sampling Manager was in constant contact with the dispatcher for each collection company to confirm that all drivers received instructions about which households not to collect.

3. Daily Schedule

5:00 a.m.	Dispatchers from GCS, CWS, and GreenTeam called the on-site residential sampling manager to verify that regular route drivers had been instructed not to collect waste or recycling from the day's list of selected households.
5:30 a.m.	Rider supervisor Tracie Bills and two other riders arrived at hauler yards to meet drivers.
6:00 a.m.	Riders left with drivers for sample collection.

8:00 a.m.	Sorting crew manager arrived at Green Waste Recovery facility and began set-up for sorting operations.
9:00 a.m.	Sorting crew arrived at Green Waste Recovery facility and completed set-up for sorting operations.
9:30 a.m.	(approximate time) Samples began arriving at Green Waste Recovery facility. Sorting crew began to sort samples.
7:00 p.m.	(approximate time) Sorting crew completed sorting of the day's samples. Sample tally forms and photos from the samples were collected by the Data Manager, who then scanned them and made electronic copies of the images.
evening and the next day	Data Manager prepared daily report for submittal to the City. Project manager reviewed report before submittal. Data manager entered sample and weight data into customized database and noted any missing data, so that samples could be "made up" promptly.

4. Sorting and Characterization of Lumped Samples of Waste or Recycling

After each lumped sample of waste or recycled material was tipped, photographs of the lumped sample were taken from all four sides using a digital camera. The *sample placard* that identified each sample was positioned so it was visible in each photograph.

Each lumped sample of waste or recycled material was then sorted into the material categories, and the sorting crew used tared plastic laundry baskets to contain the separated materials. The sorting crew members typically specialized in groups of materials, such as papers or plastics. The Crew Manager monitored the homogeneity of material in the baskets as they accumulated and rejected any materials which were improperly classified.

The Crew Manager then verified the purity of each material as it was weighed in its tared basket, using a pre-calibrated scale. The Crew Manager recorded each material weight on the *sample tally form*.

Photographs of materials were taken and identified with placards.

At the conclusion of each sorting day, the Field Crew Manager conducted a quality control review of the data recorded on each *sample tally form*. The completed *sample tally forms* were transported to the Data Manager for duplication, data entry, and recording in the daily report to the City. All digital photographs were downloaded and saved to the Data Manager's hard drive and to a back-up storage device.

5. Data To Be Collected

The following is a list of the data elements of the study, along with an indication of who was responsible for collecting or providing each data element.

A. Three lists of approximately 50 households to be visited on each day, provided by City staff.

B. Map showing the collection route for visiting each household on each relevant list, provided by GCS and GreenTeam.
C. List of "do not collect" addresses provided by the City and distributed by GCS, CWS, and GreenTeam dispatchers to regular collection route drivers. Dispatchers also were responsible for ensuring that households on the "do not collect" lists were not visited by regular route drivers.
D. List of households visited for each day, developed by the consultant team and filled in by the vehicle rider. The list included a box to check indicating that each household was visited, and boxes to check indicating that waste and/or recycled material was obtained as a sample. The list also included a space for notes regarding any unusual circumstances the rider observed at each household.
E. Sample placards, for use with photographs, provided by the consultant team, indicated the date, district, waste stream, and sample ID for each lumped sample.
F. Sample tally forms, provided by the consultant team and filled out by the manager of the sorting crew, with spaces indicating the weights of each material component of each lumped sample.
G. Annual tonnage figures for garbage and recycling collected from single-family residences in each of the three service districts, provided by the City.

6. Description of Problems or Special Conditions

The logistics of this study required close communication and detailed advanced planning with multiple hauling companies. Regular collection drivers who remembered to leave identified samples at the curb were rewarded with a daily raffle as incentive towards perfect routes. The special collection drivers, and the consultant team's rider, were relied upon to collect specially identified samples that were to be left. When a regular collection driver either forgot to leave a sample or collected the wrong sample, there was potential for missed collections.

The dispatchers, route managers, and the on-site residential sampling manager were in regular contact regarding accidentally collected cans. We think the following factors contributed to the missed collections:

- Drivers in District C were unfamiliar with the procedures for reporting missed and accidental collections.
- The initial GCS morning dispatcher was off work the second week of the study. The replacement dispatcher was also unfamiliar with the procedures for reporting missed or accidental collections.

We implemented four steps to remedy the problem. They were:

1. Review communications procedures with drivers and dispatchers. In short: if drivers had a problem, they would call dispatch. Dispatch would contact the on-site residential sampling manager. The on-site sampling manager would contact study riders and dispatch at the other hauler.
2. Additionally, riders could contact the on-site sampling manager directly whenever they left a study cart uncollected.
3. After both study routes were completed each morning, the on-site sampling manager visited the CWS and GCS dispatchers in person to verify that all study carts were accounted for, either collected by the study trucks or by the regular route drivers.
4. We contacted customer service at the haulers directly to ensure there were no complaints regarding study carts. Previously, in the first week of the study, we had

relied on the dispatchers to inform us of customer complaints (of which we had no reports).

These new procedures implemented in the second week resolved the issue of missed carts related to the waste characterization study.

C. MRF Residuals Field Data Collection Procedures

1. Allocation of Samples

Residual materials were sampled at the GreenTeam MRF and the CWS MRF. Sampled materials were residuals from single-family residences in each of the three collection districts. A total of over 1,500 pounds of residuals from 12 samples was sorted from residual materials. Four samples were taken from District B, and eight samples of the combined residuals were taken from Districts A and C.

2. Specific Procedure at GreenTeam Processing Facility

The consultant team sorted four 125-pound loads at the GT facility. Sorting occurred inside the processing building on the main floor, in an area between the sort bunkers and the baler in-feed conveyor.

GT provided the space, a loader operator to mix the materials in the bunker and deliver the samples to the sort area, and 10 bins into which the sorted materials were placed to be weighed. The consultant team provided all of the sort labor, a sorting table, placards, a scale, and a tarp for the samples. The consultant team sorted the sample materials.

GT were asked to clear the residuals bunker the evening before the sort and to run only materials from the San Jose District B curbside collection program the morning of the sort until all four samples could be taken.

Each of the four 125-pound samples to be sorted was pulled from the residuals bunker. The bucket loader operator was asked to mix all of the materials in the bunker at the time that the samples were extracted. From the mixed pile in the bunker, a sample was pulled from a pre-selected portion of the pile. That sample was placed on a tarp. Then a second sample was pulled from another part of the bunker and placed on a second tarp. Both samples were photographed from all four sides. Following the taking of photographs, the sort leader made notes on the primary contents of the sample.

3. Specific Procedure at CWS Processing Facility

The consultant team sorted eight 125-pound loads at the CWS facility. Sorting occurred inside the processing building on the main floor, in the bale storage area toward the north end of the building.

CWS provided the space and a loader operator to mix the materials in the bunker and deliver the samples to the sort area. The consultant team provided the sort labor, a scale, a sorting table, tarps for the samples, and the bins into which the sorted materials were to be placed and weighed.

Since CWS sorted residuals into two bunkers, four 125-pound samples were pulled from each of the residuals bunkers. From the mixed pile in the bunker, a bucket loader operator removed a sample from a pre-selected portion of the pile. That sample was placed on a tarp. Then a second sample was pulled from another part of the same bunker and placed on a second tarp. This process was repeated to provide two additional samples from the second residuals bunker. This entire process was repeated later in the day to collect eight samples.

4. Description of Problems or Special Conditions

MRF samples taken at the CWS Facility represent two separate residuals bunkers, without any distinction between District A and District C. Since CWS combines all of the materials into large storage piles as they are received, it was not possible to obtain separate samples from each of the two service districts.

Also, since residuals are sorted into two bunkers, our original plan was to mix the materials into one sample. With all of the activity at the site, there was not an easy way to make that happen. Therefore, MRF Sample 1 – 4 are residuals from the ‘Push-Through’ bunker and MRF Sample 5 – 8 are residuals from the ‘Walking Floor’ bunker. Both bunkers appeared to receive approximately equal quantities of materials and the two sets of samples were weighted equally in the analysis.

D. Commercial Field Data Collection Procedures

The basis for estimating City-wide commercial waste generation, subdivided into the three substreams that were targeted in this study, has been described in the body of the report. This section describes in greater detail the field methods used to plan, schedule, obtain, sample, sort, and record commercial waste samples.

The three commercial substreams are defined below:

- **Front Loader Commercial Routes:** Front loader collection is the most common form of commercial collection. A single front loader truck uses hydraulic arms to tip refuse containers ranging in size from 2 yards up to 12 yards. Front loader routes typically serve a wide variety of businesses, mixing the wastes throughout the collection process. Frequently, there are routes that serve “clusters” of like businesses, such as the restaurant district or the office park district, but wastes from many businesses are typically contained in each load.
- **Roll-off Compacting Containers:** Unlike the front loader routes, a roll-off compacting container is a sited at a single business (or multi-tenant building) and receives all wastes from that business (or building). Examples of businesses that use compactor roll-offs include big box stores, retail malls, supermarkets, warehouses, manufacturing facilities and the like. Compactor boxes range in size from 12 to 40 yards and are used to dispose of a variety of wastes.
- **Permanent Roll-off Debris Boxes:** Debris boxes also receive waste from only one business (or a multiple-tenant building). However, these boxes do not have compacting capability, which usually signifies that the characteristics of the wastes to be disposed may not be as conducive to compaction (otherwise a compactor is a more economical option). Debris boxes can range in size from 20 to 40 yards.

1. Hauler Coordination

As described in the body of this report, cooperation from the City of San Jose's two largest commercial franchise haulers was critical for obtaining information about the quantities of waste collected from the three substreams of commercial waste defined for this report. The two largest haulers, Allied Waste and Stevens Creek, collect over 85% of the volume of wastes, and virtually all of the wastes collected in dumpsters and compactor boxes. Allied Waste also operates the Newby Island Landfill, which served as the host sort facility.

At the outset of the project, the Project Team and the City held a kick-off meeting that was attended by representatives of these companies. Subsequent to the kick-off meeting, Project Team member the consultant team worked closely with representatives from both Allied Waste and Steven's Creek to acquire relevant data for development of a detailed sampling plan. In order to develop a defensible and representative sampling plan, both haulers were asked to provide commercial account data in sufficient detail to estimate waste quantities by substream. The consultant team provided each hauler with a confidentiality agreement and a request for commercial customer routing and account data for front loader accounts, roll-off compactor accounts, and permanent debris box accounts.

Detailed commercial routing and account data provided by the haulers were used to (a) verify annual quantities of commercial waste that are reported to the City by each franchise hauler, and (b) calculate defensible estimates of the quantity of wastes by substream.

Pursuant to the confidentiality agreements executed for this project, no specific data can be provided from either hauler. Annual commercial waste quantities, derived from the detailed hauler data, are provided in aggregate in the body of the report.

2. Sampling Targets and Planning

Consistent with CIWMB standard methodology, the commercial waste characterization study targeted 40 samples from each of the three substreams of commercial waste, for a total of 120 samples. For front loader and roll-off compactor box samples, samples weighing 200 to 250 pounds were targeted for sorting (also consistent with CIWMB methodology). Given the potential for bulky or homogeneous wastes in debris boxes, these loads were anticipated to require either physically sorted samples (200 to 250 pounds) or visually surveyed samples (of the entire load). For permanent debris boxes that contained largely bagged commercial municipal solid waste and/or other waste with average particle size below 12 inches, standard grab sampling and hand-sorting was performed. For debris boxes (and potentially front loader or compactor box loads) that contained bulky and/or homogeneous wastes that were not conducive to physical sorting, a visual survey of the entire load was performed. The field supervisor used his/her judgment with each incoming sample to take either a physical grab sample, or else to perform a visual volumetric sample. The physical sorting and visual surveying procedures are described in detail later in this section.

The following paragraphs describe the steps that were required to select and capture samples from a representative cross section of the front loader, roll-off compactor and debris box substreams from the two participating franchise haulers.

Based on the detailed data provided by each franchise hauler, the consultant team was able to create a list of routes and accounts receiving each type of collection service from each franchise hauler. For each commercial substream, the consultant team built a spreadsheet of the total universe of collection services for use in random selection of samples. The universe was defined differently for each substream as described below:

- **Front Loader Waste**: Both haulers were able to provide detailed data about the number of routes, average route yardage, and average weight collected for all commercial routes servicing San Jose businesses. Based on the uniformity of front loader routes, "routes" were used as the basis for randomly sampling from this substream.
- **Roll-off Boxes (Compactor and Debris)**: Both haulers were able to provide both scheduled and on-call roll-off account data for both box types. This information included both the size of the box (in cubic yards) and the collection frequency (days of the week or else the expected on-call frequency). Because of the variance in box size and collection frequency across commercial account, samples were selected based on an "Nth cubic yard" approach. Under this approach, each account was given an opportunity to be randomly selected in proportion to its contribution to the total waste substream (measured by yardage collected). So, businesses with larger boxes and/or higher collection frequencies had a proportionately greater chance of being selected than businesses with smaller boxes or lower collection frequency.

Ultimately, the consultant team selected a sufficient number of front loader routes, compactor boxes, and permanent debris boxes from each hauler to acquire the targeted 120 samples (as a contingency, a total of 137 loads were actually selected). Because of the confidentiality agreements with participating haulers, it is not possible to report on the specific routes or roll-off accounts that were selected.

Sampling and sorting took place at the Newby Island Landfill from March 17 through March 28 (excluding Saturday and Sunday). As a final step in the planning process, it was necessary to work out a protocol for assuring that targeted loads were delivered to the host sorting facility, which was the Newby Island Landfill. Prior to the outset of the field sorting/sampling, each hauler was provided with a daily list of the front loader routes and roll-off accounts to be delivered for sorting. Allied Waste internalizes its commercial waste and already delivers to Newby Island. Stevens Creek made special arrangements to deliver targeted loads to the Newby Island Landfill for the duration of this study.

Each afternoon, the haulers were provided with a set of placards to be given to each of the targeted load equipment operators as a reminder to deliver their load for sorting. Once the targeted loads arrived at the landfill, they were directed by the scale house to a staging area for dumping. This process worked effectively for the most part. Although several loads throughout the study were not delivered (for a variety of expected reasons, such as driver oversight, rescheduled pull of a targeted roll-off, etc.), the total sampling target was ultimately achieved because of the number of contingency loads. Table 47 below summarizes the targeted and actual number of samples obtained from each of the three substreams.

Table 47. Comparison of Targeted vs. Actual Commercial Waste Samples

Substream	Proposed	Actual	Difference
Commercial Front loaders Physical	40	41	+1
Commercial Front loaders Visual	0	1	+1
Compactors Physical	40	40	0
Compactors Visual	0	2	+2

Debris Boxes Physical	20 (estimate)	27	+6
Debris Boxes Visual	20 (estimate)	14	-6
Total	***120***	***126***	***+6***

As shown in the table, 126 samples were ultimately obtained. As expected, virtually all of the front loader and compactor box samples were physically sorted, although it was of interest to note that three of these loads contained a mix of materials that was more conducive to visual surveying.[5] Prior to the field study, the consultant team estimated that roughly half of the incoming loads would be visually surveyed, with the other half physically sampled. In practice, two-thirds of the loads were physically sorted.

3. Overview of Daily Field Activities

The Newby Island Landfill opens at 5:00 am and closes at 6:00 pm daily. All sampling and sorting, including work area set-up and site clean-up, was performed during these hours of operation. The daily schedule for the sampling period is presented below.

Time	Activity
Preceding Afternoon	The consultant team transmitted the targeted loads and/or placards to each hauler and followed up with a telephone call to confirm receipt
4:45 AM	The consultant team Field Supervisor arrived prior to facility opening time to check in at the scale house and obtain the several targeted trucks that were waiting at the gate for their first tip each day. The Field Supervisor obtained and stored grab samples for the arrival of the sorting team, or else began visual surveys.
7:00 AM	Crew Chief and sorting crew arrived at the Landfill to set up the work area and commence sorting activities
3:00 PM	Field Supervisor confirmed receipt of all samples for that day and contacted participating haulers to confirm next day's targeted loads (as well as to address any shortfalls or problems that arose)
4:30 PM	Sorting team concluded daily sort activities, including site clean-up. Checked out with Landfill Facility Manager
Evening	Daily sample summary and field data forms were submitted for data entry and quality control review.

4. Sort Crew Training

All members of the sorting team participated in health and safety training, led by Newby Island Landfill staff, on the first day of the sorting event. In addition, The consultant team conducted a formal training session on the first day of sample sorting, March 17, 2008. Prior to the first sample being sorted on March 17 (and again as a refresher on March 24), the Crew Chief and Field Supervisor set up the work area with appropriate field supplies, and subsequently trained

[5] The visually surveyed loads consisted of two compactor boxes from a local hospital containing entirely autoclaved (treated) medical waste, and a front loader that contained a large fraction of carpet/backing and containers of cooking grease.

the sorting crew. A third professional staff person was deployed for the first two days to assist with sorter orientation, process training, and safety and health training of the sorting team for the first two days of the field sort. After several days, the sort labor achieved consistency with repeat laborers, making the field data collection progress smoothly.
Training included:

- General facility overview;
- Facility-specific health and safety requirements;
- Personal protective equipment (PPE) requirements;
- Waste handling techniques; and
- Productivity strategies and daily sorting targets.

During the course of the study, the work site was visited and observed by City of San Jose and host facility staff.

5. Equipment List

The following equipment was provided by The consultant team for use during the sort:

- 20' x 20' tent for the sorting area
- Custom sorting table (4' x 8') (see Figure 1)
- Labeled plastic bins to hold sorted materials (see Figure 1)
- Digital scale plus spare batteries
- Digital camera
- Clipboards for data recording
- Plastic tarps for sample storage
- Shovels, rakes, brooms, and other hand tools
- Orange safety cones to delineate work area on the landfill face
- Personal protective equipment for each sorting team member
- Safety vests and hard hats, as well as other equipment required by the Newby Island Landfill
- Safety/medical kit

The Newby Island Landfill provided the following equipment and support:

- Designated work area with its own tip face for processing all targeted samples
- Loader and operator to obtain grab samples from targeted loads, and to spread out visually surveyed loads
- Port-o-let
- Two-way radios for communication with Landfill personnel (scalehouse, operators, etc.)
- Dozer and compactor for processing unsorted portions of targeted loads as well as sorted and weighed material that is discarded.

6. Sorting and Characterization of Samples

The Newby Island Landfill was able to provide a designated work area for the sorting. This work area was adjacent to the tip face, and had its own tip face, compactor, dozer, and loader. A loader operator was available to obtain grab samples and to process tipped and unused or sorted wastes into the landfill. The sort area was configured and maintained to optimize sorting efficiency and to assure the safety of sort crews.

a) Sample Selection

Based on the final sampling plan, which contained detailed information about the daily targeted routes and roll-off boxes from each participating hauler, the Field Supervisor knew each day which front loader, compactor box, and permanent debris box loads to expect. Incoming vehicle summary forms were created to record data about the truck and load, primarily to confirm that the load meets the selection criteria used in sampling loads. Information was noted on the vehicle selection form, along with a unique identifying number associated with that vehicle on that day. Placards were collected from each targeted incoming vehicle. The field crew supervisor also noted any unusual circumstances associated with the load or the sample.

To meet the number of samples needed, it must be noted that some of the scheduled targeted samples were replaced with non-targeted incoming loads. This was especially true for permanent debris boxes. As described previously, the universe of businesses with this form of collection is small, and unlike compactor boxes and front loader routes, there was not a steady stream of such loads to sample. Accordingly, The consultant team relied on frequent communication with the dispatchers at both Allied Waste and Stevens Creek to identify and obtain on-call debris box loads sourced from commercial (non construction and demolition) establishments. The consultant team performed a visual assessment of these loads to confirm that they were not in fact temporary debris (i.e., C&D debris) loads. However, because of the infrequent nature of servicing these accounts, it cannot be ruled out that one or more of the samples that were ultimately accepted as a permanent debris box load could have contained some C&D material.

Table 48 below shows the number of proposed targeted incoming loads sampled and the actual sampled targeted loads. As shown, virtually all of the targeted frontload routes were obtained, and most of the targeted compactor box loads were obtained. Due to their scarcity, the greatest fraction of non-targeted loads were taken from debris boxes.

Table 48. Proposed Targeted Sample Loads vs. Actual Targeted Loads Sampled

Targeted Substream	Proposed Targeted Samples	Acquired Targeted Samples	Acquired Non-Targeted Sampled	Total Samples Acquired
Frontload Routes	50	41	1	42
Compactor Boxes	46	37	6	43
Permanent Debris Boxes	41	31	10	41
Total	137	109	17	126

b) Taking Samples from Selected Loads

Selected loads were dumped in elongated piles three to six feet high. From each selected load, one sample of waste was selected using an imaginary 16-cell grid superimposed over the dumped material. The Field Supervisor identified the randomly selected cell to be extracted. Then, with the assistance of a loader operator provided by the Newby Island Landfill, a sample of waste weighing at least 200 pounds was removed by machine from the designated cell and placed on a tarp. (If the sample was not sorted immediately and there was a chance of precipitation, the sample was also be covered with another tarp.) Each sample was labeled by its identifying number using brightly colored spray paint and photographed.

c) Sorting

Once the sample was acquired and placed on a tarp, the material was sorted by hand into the prescribed component categories. Plastic bins (typically 18 to 22 gallon) with sealed bottoms were used to contain the separated components. The sorting crew members specialized in groups of materials, such as papers or plastics.

The Crew Chief monitored the homogeneity of the component bins as they accumulated, rejecting and re-sorting materials that were improperly classified. The project benefited from a capable sort crew that remained unchanged for the duration of the project after replacements during the first two days. The Crew Chief further verified the purity of each component during the weigh-out, before recording the weight into the database. Materials were sorted to particle size of 2-inches or less by hand, until no more than a small amount of homogeneous fine material ("mixed residue") remained. The layer of mixed 2-inch-minus material was allocated to the appropriate categories based on the best judgment of the Crew Chief — most often a combination of Other Paper, Other Organics, or Food Waste. The overall goal was to sort each sample directly into component categories in order to reduce the amount of indistinguishable fines or miscellaneous categories.

Table 49 summarizes the weight of the sorted samples for each commercial waste substream. Note that the 200 pound target was achieved in all but four samples out of the 109 physically sorted samples. Under-weight samples were evaluated for the composition of wastes and it was determined that these lower weights did not appear to introduce bias into the overall results; as such the samples were kept in the statistical analysis.

Table 49. Sorted Sample Summary

Commercial Waste Stream	Average Weight of Sample	Number of Samples Less than 200 LBS	Minimum Sample Weight	Maximum Weight
Commercial Frontloaders	226.6	3	148.6	318.6
Compactor Boxes	231.9	0	201.7	321.2
Permanent Debris Boxes	238.1	1	194.3	336.7

At the conclusion of each sorting day, the Field Supervisor conducted a quality control review of the data recorded on each sample tally form. The completed sample tally forms were transported to the Data Manager for duplication, data entry, and recording in the daily report to the City. All digital photographs were downloaded and saved to the Data Manager's hard drive and to a back-up storage device. Photos were provided to the City on a separate CD.

7. Visual Surveying

For permanent debris box loads that contained bulky and/or homogeneous wastes, the Field Supervisor performed a visual sample. Visual samples followed the CIWMB protocol, and entailed:

1. Obtaining the net weight and measuring the dimensions of the incoming load prior to tipping and (if possible) estimating the percent full of the vehicle.
2. Tipping the load. If it was a large load, a loader spread out the material so that it was possible to discern dense materials such as block, brick, and dirt that tend to sank to the bottom of the pile.
3. Making a first pass around the load marking the major material categories that were present in the load—pallets, furniture, dimensional lumber, etc. Estimating the percentage of

the load made up of these major materials. If possible, estimating of the yardage associated with this material. Took digital photographs from several angles.
4. Making a second pass around the load, noting the secondary material categories contained in the load. Estimate the percentage of the load made up of these materials. If possible, estimate of the yardage associated with this material.
5. Verifying that the estimated percentages sum to 100 percent, and that the estimated yardage of major material categories is realistic given the overall truck dimensions and volume.

8. Site Clean-up

At the end of each day the Project Team concluded sorting operations and performed site clean-up. Clean-up activities included:

- Organized stacking and stowing of sorting supplies in a designated location;
- Removal of sorted wastes for burial or transfer:
- Cleaning the sort area to prevent windblown litter and other situations that could attract vectors;
- Removal and discard of day-use personal protective equipment and decontaminating personnel; and
- Checking out with the Landfill Facility Manager each day.

9. Data Collected

The following is a list of the data collection forms that were used for this task.

- **Daily Target Load Form**: This form summarized the truck numbers, truck types, box size, and expected arrival time for each of the targeted loads that were scheduled to arrive at the facility each day. The form enabled targeted loads to be checked off, and also allowed pertinent information to be recorded about each targeted load.
- **Physical Sort Form**: For hand-sorted samples of waste, there was be a form on which individual material weights were recorded for each sample. This form included information about the sorting date, time, sample number, and crew chief initials. Individual samples were coded to match up with the Daily Targeted Load Form.
- **Visual Survey Form**: For debris box loads that contain bulky wastes, there was a separate visual survey form that was used to record volumetric estimates of each material category in the load. This form included information about the sorting date and time, sample number, and visual surveyor initials. Individual samples were coded to match up with the Daily Targeted Load Form.
- **Targeted Load Placards**: The consultant team also arranged to provide placards to each participating hauler to distribute to their operators delivering targeted loads. These placards also assisted scale house personnel in identifying the targeted loads.

Samples of these forms were provided to the City and included in Appendix E: Field Forms.

10. Description of Problems or Special Conditions in the Commercial Sort

The commercial study experienced no significant problems. A few items of note are mentioned below.

Although the participating franchise haulers provided detailed customer account data for all three commercial substreams, the relative scarcity of permanent debris box waste created a shortage of targeted loads on certain days of the sort. For example, on more than one day of the 10-day sampling period, even if every available permanent debris box load was delivered to the sort facility, there would not have been enough samples to achieve the daily sampling targets. Where possible, the consultant team shifted daily samples so that more debris box samples could be taken on days when more of these accounts were serviced. However, because of both the scarcity of boxes and also due to expected rates of driver oversight and re-scheduled pulls of targeted boxes, the consultant team was required to identify and acquire non-targeted commercial debris box loads while the study was in operation.

Non-targeted debris box loads included two types: (a) permanent debris boxes that were on the list of accounts previously provided by the participating haulers, but not scheduled for collection on that particular day, and (b) debris box loads that originated from commercial businesses in the City of San Jose, but were not previously identified by the participating haulers. Of the 41 total samples of debris box waste, 10 loads were obtained from deliveries that were not targeted for that specific day, and five of these 10 loads originated at establishments that had not been previously identified as having permanent debris box service.

Based on detailed discussions with the Allied and Stevens Creek dispatchers during the study, the five substitute loads were confirmed to be from commercial (i.e., non-construction) sources originating within the City of San Jose, but may not have been “permanently” sited or may not have had a well defined schedule for being pulled. These non-targeted loads were evaluated upon arrival by the Field Supervisor, who confirmed via driver interview and visual observation that they were from commercial, non-construction sources. Based on the Field Supervisor’s communications with dispatch and subsequent screening efforts, the consultant team believes that the non-targeted debris boxes were representative of this substream, and the data from these samples have accordingly been included in the statistical analysis.

Appendix C: Commercial Waste Quantities

The City of San Jose obtained reports from its franchise haulers about the quantity of material collected by each franchisee. These reports characterize wastes by the type of collection vehicle or container. At the outset of this project, the City provided summary data for both 2006 and 2007. The consultants reviewed these data and found the reports to be consistent across both years. These reports characterize the type of commercial collection service, specifying front loader wastes, compactor boxes, and open top debris boxes. Table 50 reports 2007 commercial waste disposal quantities by type of delivery based on the City's records.

Table 50. 2007 Commercial Waste Disposal Summary[6]

Hauler	Front Loader	Compacter	Debris Box	Total Tons
Allied Waste Services of Santa Clara Co.	0	88,317	18,732	107,049
Stevens Creek Disposal and Recycling	74,939	13,796	5,839	94,574
GT Waste	6,689	1,848	1,424	9,961
$99 Debris Box Service	0	0	9,341	9,341
GreenWaste Recovery	6,809	2,221	0	9,030
Valley Recycling	0	0	6,734	6,734
The Flea Market, Inc.	0	1,493	156	1,648
Number ``1`` Disposal	0	58	1,306	1,364
Recycle West	221	63	405	689
Pacific Coast Recycling	0	0	452	452
Coast Dumpster Service	0	0	255	255
A & A Recycling	0	0	162	162
Environmental Management Systems	0	134	14	148
Green Valley Disposal Co., Inc.	36	2	96	134
Sonrise Consolidated Inc	0	0	118	118
Panther Industries	115	0	0	115
Redwood Services Inc.	0	0	17	17
All Points Roll Off, Inc.	0	0	4	4
The Residential Bin Co., Inc.	0	0	2	2
Total	**88,810**	**107,931**	**45,056**	**241,798**

As shown in the table, just over 240,000 tons of commercial waste were reported in the City's system. The consultants used this information as a starting point for determining the contribution of commercial waste from the three substreams defined in the study.

The consultants entered into confidentiality agreements with the two largest commercial waste haulers, Allied Waste and Stevens Creek. Both of these haulers provided confidential internal data about the accounts, service levels, and in come cases, quantities collected from individual substreams. In general, the data provided by these participating haulers showed:
The compacter quantity shown for Allied Waste in the City-provided data is actually a combination of commercial front loader trucks and compactor trucks. The consultants split the

6 Source: City of San Jose, based on franchise hauler reports.

City-provided figure into the appropriate subcategories based on additional information provided by Allied.

The Debris Boxes figure reported by the City includes all open top debris boxes, both permanent and temporary. Therefore, it was necessary to estimate the fraction of Debris Boxes that represented permanent debris box wastes as targeted in this study (temporary debris box wastes were reported to be C&D debris and were outside the scope of this study).

The consultant team further contacted several of the non-participating haulers in Table III-1 to inquire about the prevalence of permanent debris box accounts among their reported "Loose Tons." While this survey was not comprehensive, the feedback received indicated that Allied and Stevens Creek together served substantially all of the permanent debris box accounts. In other words, the non-participating haulers are primarily servicing C&D accounts in the Loose Tons category.

Our analysis found that there were just over 200,000 tons of commercially generated wastes in San Jose in 2007. Front loader-collected commercial wastes make up 75% of all commercial wastes targeted in this study, followed by compactors at 22%. It is of interest to note that a very small fraction (less than 3%) of total commercial tons were serviced by permanent debris boxes. Stated another way, the vast majority of the debris boxes reported to the City by franchise haulers (39,265 out of 45,056 tons) were collected in temporary debris boxes, and were therefore outside the scope of this project.

Given these data, it can be concluded that the City should focus largely on generators relying on front loaders and compactors in its source reduction efforts, simply because there is significantly more waste generated that requires collection in front loaders or compactor boxes. Permanent debris box wastes are a relatively minimal fraction of the overall waste stream.

Appendix D: Material Definitions

A. Residential Waste and Recycling Material Definitions

Waste and recycled material from single-family households will be characterized using the same material list and definitions, shown below.

Organic Materials

1. **Food Waste** means food material resulting from the processing, storage, preparation, cooking, handling, or consumption of food. This type includes material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, egg shells, fruit or vegetable peels, and other food items from homes, stores, and restaurants.

2. **Yard Waste** includes plant material from any public or private landscape. Examples include leaves, grass clippings, plants, prunings, shrubs, woody plant material, branches, and stumps.

3. **Compostable Paper** includes paper that is considered unsuitable for recycling, due to food contamination or human contact, but that is suitable for typical composting operations. Examples include waxed cardboard, paper towels, food-contaminated paper plates, waxed paper, tissues, and other papers that were soiled with food during use (e.g., pizza box inserts).

Paper

4. **Newspaper** means paper used in newspapers. Examples include newspaper and glossy inserts, and all items made from newsprint, such as free advertising guides, election guides, plain news packing paper, stapled college schedules of classes, and tax instruction booklets.

5. **OCC** means unwaxed corrugated cardboard containers/boxes.

6. **Mixed Papers** means all other types of papers accepted in the city's recycling program. Examples include books (paperback), carbonless paper, catalogs, cereal and cracker boxes, colored paper, computer paper, construction paper, coupons, egg cartons, envelopes, gift wrap, junk mail, magazines, paper bags, shoe boxes, shopping bags, telephone books, white office paper, juice boxes and cartons, and milk and cream cartons.

7. **Other paper** means items made mostly of paper that do not fit into any of the above types and may be combined with minor amounts of other materials such as wax or glues. Typically, this is paper with other materials attached in sufficient quantities that it would be considered to be contaminated by a typical MRF. Examples include three-ring binders containing paper, or plastic packaging glued to paper or cardboard, cigarette boxes, Tyvek, and paper mache.

Glass

8. **Recyclable Glass** means brown, clear, green, or colored glass bottle and jars, whole or broken, of any size. Examples include clear soda bottles, brown beer bottles, green wine bottles, mayonnaise jars, and jam jars.

9. **Other glass** means glass that cannot be put in any other type or subtype. It includes items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal and other glass tableware, mirrors, non-fluorescent light bulbs, auto windshields, candle holders, and other glass not typically accepted by a MRF.

Metal

10. **Aluminum Beverage Cans** means any food or beverage container that is made mainly of aluminum. Examples include most aluminum soda or beer cans.

11. **Aluminum Foil** means any thin non-ferrous metal item that is formable using hand pressure.

12. **Steel (Tin) Cans** means rigid containers made mainly of steel. These items will stick to a magnet and may be tin-coated. This subtype is used to store food, beverages, paint, and a variety of other household and consumer products. Examples include canned food and beverage containers, pet food cans, empty metal paint cans, empty spray paint and other aerosol containers, and bimetal containers with steel sides and aluminum ends.

13. **Other Scrap Metal** includes ferrous and non-ferrous metal items, other than items described previously, These items may be made of aluminum, copper, brass, bronze, lead, zinc, iron, or other metals. Examples include aluminum pie pans, aluminum furniture, appliances, small metal cast iron pans, metal lids and caps, pots and pans, metal. The "rule of thumb" for classifying an object in this category is that it must not fit in the recyclable metal categories described above, and the amount of metal in the object must outweigh the amount of non-metal materials that are part of the object.

14. **Other metal** means metal that cannot be put in any other type or subtype. This type includes items made mostly of metal but combined with other materials and items made of both ferrous metals and non-ferrous metal combined. Examples include small non-electronic appliances such as toasters and hair dryers, motors, insulated wire, metal window blinds, and finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction.

Plastic

15. **#1 PET Bottles and Containers** means clear or colored PET containers. When marked for identification, it bears the number "1" in the center of the triangular recycling symbol and may also bear the letters "PETE" or "PET." The color is usually transparent green or clear. A PET container usually has a small dot left from

the manufacturing process, not a seam. It does not turn white when bent. Examples include plastic soda, water, or juice bottles, dairy tubs, clamshell containers, and salsa tubs.

16. **#2 HDPE Bottles and Containers** means natural and colored HDPE containers. This plastic is usually either cloudy white, allowing light to pass through it (natural) or a solid color, preventing light from passing through it (colored). When marked for identification, it bears the number "2" in the triangular recycling symbol and may also bear the letters "HDPE." Examples include milk jugs, water jugs, detergent bottles, some hair-care bottles, empty motor oil, empty antifreeze, and other empty vehicle and equipment fluid containers marked with Number "2".

17. **#3, #4, #5 and #7 Bottles and Containers** means plastic containers made of types of plastic other than HDPE, PET, or polystyrene. Items may be made of PVC or PP. When marked for identification, these items may bear the number "3", "4", "5", or "7" in the triangular recycling symbol. This subtype also includes unmarked plastic bottles and containers. Examples include baby wipe containers, flower pots, food containers, household cleaner bottles, prescription bottles, and shampoo bottles.

18. **Plastic Bags and Other Film** means flexible plastic sheeting, uncontaminated with food or garbage residue. It is made from a variety of plastic resins including HDPE and LDPE. It can be easily contoured around an object by hand pressure. Examples includes grocery bags, shopping bags, dry-cleaning plastic bags intended for 1-time use, newspaper bags, produce bags, and film plastic used for large-scale packaging or transport packaging such as shrink-wrap, mattress bags, furniture wrap, and film bubble wrap. This category does not include garbage bags.

19. **Polystyrene** means non-food soiled Styrofoam containers and packing materials. Examples include cups and plates, egg cartons, foam packing, meat trays, packing "peanuts," take-out and other food and beverage containers.

20. **Durable plastic items** means products made entirely of plastic meant for multiple use. Examples include toys, toothbrushes, vinyl hose, milk crates, plastic pallets, eating utensils, plastic lawn furniture, fiberglass products, and foam carpet padding.

21. **Other plastic** means plastic that cannot be put in any other type or subtype. They are usually recognized by their optical opacity. This type includes items made mostly of plastic but combined with other materials. Examples include disposable razors, pens, lighters, and plastic toys with a significant other material component.

Textiles

22. **Textiles** means items made of thread, yarn, fabric, or cloth. Examples include clothes, cotton, linen, polyester, rayon, wool, fabric trimmings, draperies, carpet, and all natural and synthetic cloth fibers. This category does not include cloth-covered furniture, mattresses, leather shoes, leather bags, or leather belts. This category also does not include textiles that are wet, contaminated with food, chemicals, or other substances, or that are dirty.

Other Potentially Recyclable Materials (not on city list)

23. **TVs and CRT Monitors** means items containing a cathode ray tube (CRT). Examples include televisions, CRT computer monitors, and other items containing a cathode ray tube (CRT).

24. **Electronics** means items containing a circuit board, including computers, electronic computer accessories, and other consumer electronics

25. **Automotive Batteries** means any type of automotive battery including both dry cell and lead acid.

26. **Tanks** means metal containers used for storing gasses. Examples include helium and propane tanks.

27. **Tires** means vehicle tires. Examples include tires from trucks, automobiles, motorcycles, heavy equipments, and bicycles.

28. **Oil Filters** means metal oil filters used in motor vehicles and other engines, which contain a residue of used oil.

29. **Wood** means wood waste from non yard waste sources. Examples include dimensional lumber, pallets, crates, and plywood.

30. **Other Universal Waste** means hazardous wastes that may contain mercury, lead, and other substances hazardous to human and environmental health. Examples include thermostats, mercury-containing items, non-automotive batteries, fluorescent tubes, discharge lamps, and mercury vapor lamps.

Non-Recyclable Materials

31. **Non-recyclable materials**
    - **Garbage sorts** means items not classified above. Examples of material in this category include mattresses, box springs, household hazardous materials, plastic trash bags, paint, disposable diapers, hypodermic needles, ceramics, animal carcasses, ash, animal feces, furniture, contaminated textiles, shingles, drywall, and other construction materials.
    - **Recycling sorts** means items not classified above. Examples of material in this category include mattresses, box springs, household hazardous materials, plastic trash bags, paint, disposable diapers, hypodermic needles, ceramics, animal carcasses, ash, animal feces, furniture, contaminated textiles, shingles, drywall, and other construction materials. This category also includes closed opaque plastic bags with unknown contents.

B. MRF Residuals Material Definitions

Materials in the MRF residuals stream from single-family households will be characterized using the material list shown below:

1. **Film Plastics** means flexible plastic sheeting. It is made from a variety of plastic resins including HDPE and LDPE. It can be easily contoured around an object by hand pressure. Examples includes grocery bags, shopping bags, dry-cleaning plastic bags intended for 1-time use, newspaper bags, produce bags, and film plastic used for large-scale packaging or transport packaging such as shrink-wrap, mattress bags, furniture wrap, and film bubble wrap. This category does not include garbage bags.
2. **Other/Rigid Plastics** means all other plastic objects other than film plastic. Examples include bottles and containers, mop buckets, plastic outdoor furniture, plastic toys, CDs, plastic stay straps, and sporting goods, and plastic house wares such as dishes, cups, and cutlery. This type also includes building materials such as house siding, window sashes and frames, housings for electronics (such as computers, televisions and stereos), fan blades, impact-resistance cases (e.g. tool boxes, first aid boxes, tackle boxes, sewing kits, etc.), and plastic pipes and fittings.
3. **Dimensional Wood** means wood waste from non yard waste sources. Examples include dimensional lumber, pallets, crates, and plywood.
4. **Plant Trimmings** means plant material from any public or private landscape. Examples include leaves, grass clippings, plants, prunings, shrubs, woody plant material, branches, and stumps.
5. **Paper** means any item that is primarily made of paper. Examples include newspapers, phone directories, white office paper, magazines, and cardboard.
6. **Textiles** means items made of thread, yarn, fabric, or cloth. Examples include clothes, cotton, linen, polyester, rayon, wool, fabric trimmings, draperies, carpet, and all natural and synthetic cloth fibers.
7. **Ferrous Metals**, and alloyed ferrous scrap metals, means items made mainly of steel to which a magnet adheres and also includes stainless items. Examples include tin/steel cans, major appliances, and other ferrous metals.
8. **Miscellaneous Organics** means all combustible or compostable organics not classified elsewhere.
9. **All other material** means items not classified elsewhere.

All materials that can be sorted and identified will be placed in one of the eight categories listed. All materials that are too small to be identified will be categorized as "all other material."

C. Commercial Waste Material Definitions

Commercial samples will be characterized using the material list and definitions shown below.

Paper

1. **Uncoated OCC/Kraft** means Uncoated Corrugated Cardboard that usually has three layers. The center wavy layer is sandwiched between the two outer layers. It does not have any wax coating on the inside or outside. Examples include shipping and moving boxes, computer packaging cartons, sheets and pieces of boxes and cartons, Kraft paper bags, and other Kraft paper. Does not include chipboard.

2. **Wax Coated OCC** means OCC with a wax coating on the inside or outside to prevent degradation from moisture. Examples include produce boxes from a grocer.

3. **Books** means hard cover and paperback books.

4. **Mixed Recyclable Paper** means all other recyclable papers not elsewhere described. Includes Newspaper and inserts; Magazines/Catalogs and other items made of glossy coated paper; Phone Books and Directories with thin paper between coated covers and a spine bound with glue; Junk Mail including envelopes with/without windows and enclosures; Chipboard/Paperboard such as cereal and tissue boxes; colored ledger paper and other dry paper. Mixed Recyclable Paper may be combined with minor amounts of other materials such as wax or glues. Examples include manila folders, manila envelopes, index cards, white envelopes, white window envelopes, and carbonless forms.

5. **High Grade Paper** means uncolored bond, rag, or stationary grade paper, with or without ink. Examples include white photocopy, white laser print, letter paper, and computer paper used for computer printouts.

6. **Compostable Paper** means low grade paper that is not capable of being recycled, as well as food contaminated paper. Examples include paper towels, paper plates, waxed papers, aseptic packages, polycoated (gable top) cartons, and tissues.

7. **Remainder/Composite Paper** means items made mostly of paper but combined with large amounts of other materials such as wax, plastic, glues, foil, wire, food and moisture. Examples include cellulose insulation, blueprints, sepia, onion skin, foiled lined fast food wrappers, carbon paper, self-adhesive notes, and photographs.

Glass

8. **Glass Bottles and Jars (all colors)** means clear, green, brown, and other colored glass bottles and jars containing beverages, food, or consumable liquids with or without a CRV label. Examples include whole or broken clear or colored soda, beer bottles, fruit juice bottles, peanut butter jars, mayonnaise jars, wine bottles, cosmetic jars, and non prescription medical bottles.

9. **Flat Glass** means clear or tinted glass that is flat. Examples include glass window panes, doors, and table tops, flat automotive window glass (side windows), safety glass, mirrors, and architectural glass. This does not include windshields, laminated glass, or any curved glass.

10. **Remainder/Composite Glass** means items made mostly of glass but combined with other materials that cannot be put in any other type or subtype. Examples include Pyrex, crystal and other glass tableware, auto windshields, and incandescent light bulbs.

Plastics

11. **#1 PET Bottles and Containers** means clear or colored PET containers. When marked for identification, it bears the number "1" in the center of the triangular recycling symbol and may also bear the letters "PETE" or "PET." The color is usually

transparent green or clear. A PET container usually has a small dot left from the manufacturing process, not a seam. It does not turn white when bent. Examples include plastic soda, water, or juice bottles, dairy tubs, clamshell containers, and salsa tubs.

12. **#2 HDPE Bottles and Containers** means natural and colored HDPE containers. This plastic is usually either cloudy white, allowing light to pass through it (natural) or a solid color, preventing light from passing through it (colored). When marked for identification, it bears the number "2" in the triangular recycling symbol and may also bear the letters "HDPE." Examples include milk jugs, water jugs, detergent bottles, some hair-care bottles, empty motor oil, empty antifreeze, and other empty vehicle and equipment fluid containers marked with Number "2".

13. **#3, #4, #5 and #7 Bottles and Containers** means plastic containers made of types of plastic other than HDPE, PET, or polystyrene. Items may be made of PVC or PP. When marked for identification, these items may bear the number "3", "4", "5", or "7" in the triangular recycling symbol. This subtype also includes unmarked plastic bottles and containers. Examples include baby wipe containers, flower pots, food containers, household cleaner bottles, prescription bottles, and shampoo bottles.

14. **Expanded Polystyrene Food Service** means items used for food packaging or food service, such as food trays and egg cartons. Items are typically marked with #6 and/or PS.

15. **Expanded Polystyrene Packaging** means formed or sheet EPS items marked with a PS or a #6, used for packaging and shipping. Also includes EPS packaging peanuts, packaging blocks, insulation, and coolers.

16. **Other Food Service Plastics** means any non-expanded plastic items associated with food service made of any type of plastic. Examples include food containers such as yogurt cups, microwave food trays, and clamshell-shaped fast food containers, both clear and opaque, including those made with #1 PET and #6 rigid polystyrene. Examples include plastic cups, cutlery, plates, bowls, and straws.

17. **Recoverable Film** means plastic film that can be recycled, and has not been greatly contaminated by other materials during its use. Examples include clean, recyclable plastic film, such as bread, grocery, newspaper, dry cleaner plastic film bags, film packaging, and wrapping such as shrink wrap. Predominantly #2 HDPE or #4 LDPE/LLDPE films.

18. **Other Film** means plastic film that is contaminated or otherwise non-recyclable. Examples include other types of plastic bags (sandwich bags, zipper-reclosable bags, produce bags, frozen vegetable bags), food wrappers such as candy-bar wrappers, mailing pouches, bank bags, X-ray film, metalized film (wine containers and balloons), and plastic food wrap.

19. **Other Rigid Plastic** means other rigid plastic not elsewhere classified. Examples include foam packing blocks (not including expanded polystyrene blocks), plastic strapping, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, imitation ceramics, handles and knobs, plastic lids, some kitchen ware, toys, plastic string (as used for hay bales), and plastic rigid bubble/foil packaging (as for

medications). This type also includes durable plastic items such as all-plastic toys, CD's, and plastic house wares.

20. **Remainder/Composite Plastic** means plastic items not elsewhere classified, as well as items made mostly of plastic but combined with other materials. Examples include auto parts made of plastic attached to metal, plastic outdoor furniture, and other objects that contain more than 50% plastic, etc.

Metal

21. **Ferrous/Bimetal Cans** means rigid containers made mainly of steel. These items will stick to a magnet and may be tin-coated. This subtype is used to store food, beverages, paint, and a variety of other household and consumer products. Examples include canned food and beverage containers, empty metal paint cans, empty spray paint and other aerosol containers, and bimetal containers with steel sides and aluminum ends.

22. **Other Ferrous** means any predominantly iron or steel item that is magnetic, other than ferrous/bimetal cans. Examples include structural steel beams, metal clothes hangers, rebar, metal pipes, security bars, and scrap ferrous items.

23. **Appliances** means white goods made mostly of metal but combined with other materials and items made of both ferrous metals and non-ferrous metal combined. Examples include large appliances and parts thereof (such as stoves, refrigerators, and washers) and small appliances (such as fans, irons, and hair dryers).

24. **Aluminum Cans** means any food or beverage container, CRV or otherwise, made mainly of aluminum. Examples include aluminum soda or beer cans and some pet food cans. This does not include bimetal containers with steel sides and aluminum ends.

25. **Other Non-Ferrous** means any metal item, other than aluminum cans, that is not magnetic. These items may be made of aluminum, copper, brass, bronze, lead, zinc, or other metals. Examples include aluminum window frames, aluminum siding, copper wire, shell casings, brass pipe, and aluminum foil.

Organic Materials

26. **Food Wastes** means food material resulting from the processing, storage, preparation, cooking, handling, or consumption of food. This type includes material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, egg shells, fruit or vegetable peels, and other food items from homes, stores, and restaurants. This type also includes grape pomace and other processed residues or material from canneries, wineries, or other industrial sources.

27. **Leaves/Grass/Brush/Stumps** means plant and woody material from any public or private landscapes. Examples include leaves, grass clippings, plants, pruning, trimmings, shrubs, branches, and stumps.

28. **Cooking Grease** means liquid or solid oil or grease used for cooking food. Examples include used or unused grease and oils such as Crisco or vegetable oils.

29. **Disposable Diapers** means disposable baby diapers, feminine hygiene products, and adult protective undergarments.

30. **Textiles/Leather/Rubber** means items made of thread, yarn, fabric, or cloth. Examples include clothes, fabric trimmings, draperies, all natural and synthetic cloth fibers, leather or rubber shoes, leather bags, and leather belts.

31. **Remainder/Composite Organics** means organic material that cannot be put in any other type or subtype. This type includes items made mostly of organic materials but combined with other materials. Examples include cork, hemp rope, hair, cigarette butts, full vacuum bags, sawdust, and animal feces.

Construction and Demolition Materials

32. **Asphalt Composition Shingles,** commonly known as three tab roofing, means composite shingles composed of fiberglass or organic felts saturated with asphalt and covered with inert aggregates. This does not include built-up roofing.

33. **Other Asphalt Roofing** means materials such as roofing tar paper/felt, a heavy paper impregnated with tar or a fiberglass or polyester fleece impregnated with tar and used as part of a roof for waterproofing; built-up roofing material made with layers of felt, asphalt, aggregates, and attached roofing tar and tar paper normally used on flat/low pitched roofs usually on commercial buildings; roofing mastic, a paste-like material used as an adhesive or seal in roofing applications; and any other roofing material containing asphalt that cannot be put into any of the other roofing material types.

34. **Concrete/Brick/Asphalt** means materials made of concrete, brick, or asphalt. Concrete is a hard material made from sand, gravel, aggregate, cement mix, and water. Examples include pieces of building foundations, concrete paving, and cinder blocks, man-made paving stones, and brick. Asphalt means a black or brown, tar-like material mixed with aggregate used as a paving material.

35. **Untreated/Unpainted Lumber** means non-treated processed wood for building, manufacturing, landscaping, packaging, and non-treated processed wood from demolition. Examples include dimensional lumber, lumber cutoffs, wood scraps, and non-shingle wood siding. May contain nails or other trace contaminants.

36. **Painted/Stained Lumber** means wood that has had an external coating applied, been pressure treated, chemically treated (with copper etc.) or treated with creosote. Examples include railroad ties, marine timbers and pilings, landscape timbers, telephone poles, painted lumber, and stained lumber. May contain nails or other contaminants.

37. **Wood Shingles** means natural, painted, or stained wood shingles used for roofing or siding materials for living or business structures.

38. **Clean Gypsum Board** means unpainted interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused, broken or whole sheets of sheetrock, drywall, gypsum board, plasterboard, gypboard, gyproc, and wallboard.

39. **Ceramics** means inorganic non-metallic materials which are formed by the action of heat. Examples include clay pottery, tiles, stoneware, dishes, toilets, and other cement glasses.

40. **Carpet and Carpet Padding** means any material consisting mainly of carpet or carpet padding. Carpet means flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material. Carpet Padding means plastic, foam, felt, and other materials used under carpet to provide insulation and padding.

41. **Other Rock/Soil/Fines** means rock pieces of any size and soil, dirt, and other matter. Examples include rock, stones, and sand, clay, soil and other unspecified fines less than 1/2 inch in diameter.

42. **Remainder/Composite C&D** means construction and demolition material that cannot be put in any other type or subtype. This type may include items from different categories combined, which would be very hard to separate. Examples include metal sinks, fiberglass insulation, painted gypsum board ceiling tiles, caulk tubes, and other none specified C&D material.

Hazardous Materials

43. **Household Hazardous Waste** means paint, antifreeze, motor oil, other vehicle fluids, oil filter, pesticide, and other chemicals. Containers must have liquids. Examples include latex and oil paints or stains and all automotive fluids.

44. **Pharmaceuticals/Household Medical (sharps)** means any prescription medications and sharp objects used for medical procedures such as needles.

45. **Other Remainder Composite Hazardous Materials** means household hazardous material that cannot be put in the "Paint", "Automotive Fluids", "Used Oil", or "Batteries" subtypes. This type also includes household hazardous material that is mixed. Examples include household hazardous waste which, if improperly put in the solid waste stream, may present handling problems or other hazards.

Universal Waste

46. **Compact Fluorescent Bulbs (CFLs)** means a lamp tube that is able to be screwed or plugged in to a lamp or over head light that produces visible light by fluorescence.

47. **Florescent Tubes** means a two pronged glass tube whose inner wall is coated with a material that fluoresces when an electrical current causes a vapor within the tube to discharge electrons.

48. **Car and Other Lead Acid Batteries** means a battery with liquid acid and lead cells. Examples include car, truck, lawn mower, and other batteries used to store power.

49. **Household & Other Small Dry Cell Batteries** means any type of drycell battery. Examples includes flashlight, small appliance, watch, cell phone, and hearing aid batteries.

50. **Cathode ray tube (CRT)** means an evacuated glass envelope containing an electron gun (a source of electrons) and a fluorescent screen, usually with internal or external means to accelerate and deflect the electrons. When electrons strike the fluorescent screen, light is emitted. Examples include computer monitors and oscilloscopes.

51. **Electronic Devices** means large and small electronic goods that have circuitry. Examples include microwaves, stereos, VCRs, DVD players, radios, audio/visual equipment, non-CRT televisions (such as LCD televisions), computer related electronics (such as processors, mice, keyboards, laptops, disk drives, printers, modems), fax machines, personal digital assistants (PDAs), cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras.

Other Materials

52. **Ash** means a residue from the combustion of any solid or liquid material. Examples include ash from fireplaces, incinerators, biomass utilities, waste-to-energy facilities, and barbecues. This subtype also includes ash and burned debris from structure fires.

53. **Treated Medical Waste** means medical waste that has been sterilized through a steam autoclave and shares the same meaning as treated medical waste in Section 25023.5 of the Health and Safety Code.

54. **Mattresses and Box Springs** means a fabric coated framed or unframed wire coil bulky item used for sleeping.

55. **Furniture** means multi-material furniture items such as couches, chairs, hutches, tables, entertainment centers, and fragments of furniture items.

56. **Tires** means vehicle and truck tires means pneumatic tires or solid tires manufactured for use on any type of motor vehicle such as trucks, automobiles, motorcycles, and heavy equipment.

57. **Mixed Residue** means material that cannot be put in any other type or subtype in the other categories. This category includes mixed residue that cannot be further sorted (approximately 1-inch or less) and residual material from a materials recovery facility or other sorting process that cannot be put in any of the previous remainder/composite types.

Appendix E: Field Forms

This appendix includes the field forms used for this study, including:

1. Sample Placard
2. Residential Form: Physical Characterization Waste and Recycling Tally Sheet
3. MRF Residual Form: Physical Characterization Tally Sheet
4. Commercial Form: Physical Characterization Waste Tally Sheet
5. Commercial Form: Visual Characterization Waste Tally Sheet

Forms: Sample Placard

<table>
<tr><td rowspan="3">Sample ID:</td><td colspan="2">REC1</td></tr>
<tr><td colspan="2">Date: 3/17/2008</td></tr>
<tr><td>Route:
Truck 1</td><td>Service
District: A</td></tr>
</table>

Residential Form: Waste and Recycling Tally Sheet

San Jose Waste Characterization 2008 - RESIDENTIAL Page ________ of ________

	Weight 1	Weight 2	Weight 3	Weight 4	Weight 5	Weight 6	Weight 7	Weight 8	Weight 9
Organics									
Food Waste									
Yard Waste									
Paper									
Newspaper									
OCC									
Mixed Papers									
Compostable Paper									
R/C Paper									
Metal									
Aluminum Beverage									
Aluminum Foil									
Steel (Tin) Cans									
Other Scrap Metal									
R/C Metal									
Plastic									
#1 PET Containers									
#2 HDPE Containers									
#3, 4, 5 and 7 Containers									
Bags and Other Film									
Polystyrene									
Durable Plastic Items									
R/C Plastic									
Glass									
Recyclable Glass									
R/C Glass									
Textiles									
Textiles									
Non-Recyclables									
Non-Recyclables									

Other Recyclables			
TVs and CRT Monitors			
Electronics			
Automotive Batteries			
Tanks			
Tires			
Oil Filters			
Wood			
Other Universal Waste			

District: A or B or C **Recycling** ☐

Truck: #1 or #2 **Garbage** ☐

Date: **Sample ID:**

Time of arrival: **Photos Taken** ☐

If found please call 206-343-9759. Reward offered.

Form: MRF Residuals Tally Sheet

Sample number	District	MRF
Date	**Facility**	**Photos taken**
Notes		

	Weight 1	Weight 2	Weight 3	Weight 4	Weight 5	Total Weight
Film Plastics						
Other/Rigid Plastics						
Dimensional Wood						
Plant Trimmings						
Paper						
Textiles						
Ferrous Metals						
Miscellaneous Organics						
All Other Material						

Forms: Commercial Physical Tally Sheet

San Jose Commercial Physical Sort Field Sheet

Sample ID: ___________________________ Crew Chief: ________________ Load Generation Location: ________________

Date: _____________ Time: _____________ Field Supervisor: ____________ Facility Name: Newbie Island

☐ Labeled & Photographed Hauler (circle one): Stevens Creek Allied Waste

		Material Group	Weight 1 Circle if net wt	Weight 2	Weight 3	Weight 4	Weight 5
PAPER	1	OCC/Kraft					
	2	Wax Coated OCC					
	3	Books					
	4	Mixed Recyclable Paper					
	5	High Grade Paper					
	6	Compostable Paper					
	7	Remainder/Composite Paper					
GLASS	8	Glass Bottles and Jars (all colors)					
	9	Flat Glass					
	10	Other Glass					
PLASTIC	11	#1 PET Bottles/Jars (CRV and non-CRV)					
	12	#2 HDPE Bottles/Jars (CRV and non CRV)					
	13	Other Plastic Bottles & Containers (#3-#7 Bottles/Jars & Injection Molded Tubs)					
	14	Food Service Expanded Polystyrene (EPS)					
	15	Other Food Service Plastics					
	16	Expanded Polystyrene (EPS) other than Food Service					
	17	Recoverable Film					
	18	Other Film					
	19	Other Rigid Plastic					
	20	Remainder/Composite Plastic					
METAL	21	Ferrous/Bimetal Cans					
	22	Other Ferrous					
	23	Appliances					
	24	Aluminum Cans					
	25	Other Non-Ferrous					
ORGANIC	26	Food Wastes					
	27	Leaves/Grass/Brush/Stumps					
	28	Cooking Grease					
	29	Disposable Diapers					
	30	Textiles/Leather/Rubber					
	31	Remainder/Composite Organics					
C & D	32	Asphalt Composition Shingles					
	33	Other Asphalt Roofing					
	34	Concrete/Brick/Asphalt					
	35	Untreated/Unpainted Lumber					
	36	Painted/Stained Lumber					
	37	Wood Shingles					
	38	Clean Gypsum Board					
	39	Ceramics					
	40	Carpet and Carpet Padding					
	41	Other Rock/Soil/Fines					
	42	Remainder/Composite C&D					
HHW	43	HHW					
	44	Pharmaceuticals/household Medical (sharps)					
	45	Other Remainder Composite HHW					
UNIVERSAL	46	Compact Fluorescent Bulbs (CFLs)					
	47	Florescent Tubes					
	48	Car and Other Lead Acid Batteries					
	49	Household & Other Small Dry Cell Batteries					
	50	CRTs					
	51	Electronic Devices					
OTHER	52	Ash					
	53	Treated Medical Waste					
	54	Mattresses and Box Springs					
	55	Furniture					
	56	Tires					
	57	Mixed Residue					

Notes

Forms: Commercial Visual Tally Sheet

San Jose Commercial Visual Survey Field Data Sheet

Sample ID:___________________ Field Supervisor: __________________________________

☐ Labeled & Photographed Facility Name: Newby Island Landfill

Date: _______________ Time: ___________ Load Generation Location: ___________________________

Hauler (circle): Stevens Creek Allied Waste Load Weight: ________________________ pounds or tons

Container Yardage: _____________________ Percent Full: _______ Load Dump Dimensions:______________________________

		Material Group	% By Volume	% By Volume	Notes
PAPER	1	Uncoated OCC/Kraft	☐		
	2	Wax Coated OCC			
	3	Books			
	4	Mixed Paper/Other Recyclable Paper			
	5	High Grade Paper			
	6	Compostable Paper			
	7	Remainder/Composite Paper			
				Subtotal must equal 100%	
GLASS	8	Glass Bottles and Jars (all colors)	☐		
	9	Flat Glass			
	10	Compact Fluorescent Bulbs (CFLs)			
	11	Florescent Tubes			
	12	Other Glass			
				Subtotal must equal 100%	
PLASTIC	13	#1 PET Bottles/Jars (CRV and non-CRV)	☐		
	14	#2 HDPE Bottles/Jars (CRV and non CRV)			
	15	Other Plastic Bottles & Containers (#3-#7 Bottles/Jars & Injection Molded Tubs)			
	16	Food Service Expanded Polystyrene (EPS)			
	17	Other Food Service Plastics			
	18	Expanded Polystyrene (EPS) other than Food Service			
	19	Recoverable Film			
	20	Other Film			
	21	Other Rigid Plastic			
	22	Remainder/ Composite Plastic			
				Subtotal must equal 100%	
METAL	23	Ferrous/Bimetal Cans	☐		
	24	Other Ferrous			
	25	Appliances			
	26	Aluminum Cans			
	27	Other Non-Ferrous			
				Subtotal must equal 100%	
ORGANIC	28	Food Wastes	☐		
	29	Leaves/Grass/Brush/Stumps			
	30	Cooking Grease			
	31	Disposable Diapers			
	32	Textiles/Leather/Rubber			
	33	Remainder/Composite Organics			
				Subtotal must equal 100%	
C&D MATERIALS	34	Asphalt Composition Shingles	☐		
	35	Wood Shingles			
	36	Other Asphalt Roofing			
	37	Concrete/Brick/Asphalt			
	38	Other Rock/Soil/Fines			
	39	Untreated/Unpainted Lumber			
	40	Painted/Stained Lumber			
	41	Clean Gypsum Board			
	42	Ceramics			
	43	Carpet and Carpet Padding			
	44	Remainder/Composite C&D			
				Subtotal must equal 100%	
HHW	45	HHW	☐		
	46	Pharmaceuticals/Household Medical (sharps)			
	47	Treated Medical Waste			
	48	Other Remainder Composite HHW			
	49	Car and Other Lead Acid Batteries			
	50	Household & Other Small Dry Cell Batteries			
				Subtotal must equal 100%	
OTHER	51	CRTs	☐		
	52	Electronic Devices			
	53	Ash			
	54	Mattresses and Box Springs			
	55	Furniture			
	56	Vehicle Tires			
	57	Mixed Residue			
				Subtotal must equal 100%	

Appendix F: Acknowledgements

This section of the final report will include gratitude for the facility crews and hauling companies for their help making this study possible.